(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 268 237 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 87116851.3

(22) Date of filing: 16.11.87

(51) Int. Cl.4: G01N 1/10 , G01N 35/00 , G01F 11/02

(30) Priority: 17.11.86 US 931476

(43) Date of publication of application: 25.05.88 Bulletin 88/21

(84) Designated Contracting States: AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: ABBOTT LABORATORIES
Abbott Park Illinois 60064(US)

(72) Inventor: Hayes, Donald J.
2012 Tampicko Drive
Plano Texas 75075(US)
Inventor: Wallace, David B.
9929 Wood Forest
Dallas Texas 75243(US)
Inventor: Verlee, Donald J.
563 Drake Street
Libertyville Illinois 60048(US)
Inventor: Houseman, Kenneth R.
1520 S. Main Street
Racine Wisconsin 53403(US)

(74) Representative: Modiano, Guido et al
MODIANO, JOSIF, PISANTY & STAUB
Modiano & Associati Via Meravigli, 16
I-20123 Milan(IT)

(54) Apparatus and process for reagent fluid dispensing and printing.

(57) A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube, comprising an orifice at one end and a fluid receiving aperture at the other end, is concentrically mounted within a cylindrical piezo-electric transducer. The fluid receiving aperture is connected to a reservoir containing a selected reagent by means of a filter. The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer and the volume defined by the jetting tube to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer and the volume of the jetting tube to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice. The droplet may be directed to impact a printing medium or collected in a dispensing recepticle.

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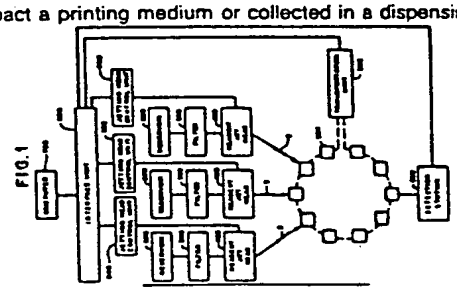

FIG.1

APPARATUS AND PROCESS FOR REAGENT FLUID DISPENSING AND PRINTING

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and process for dispensing and printing reagent fluids, wherein a transducer is used to propel small quantities of the fluid towards a positioned target.

Diagnostic assays often require systems for metering, dispensing and printing reagent fluids. In the case of metering and dispensing, such systems comprise both manual and automatic means. For purposes of practicality, the present background discussion will focus on the methods of metering and dispensing 100 micro-liter volumes or less.

The manual systems of metering and dispensing include the glass capillary pipet; the micro-pipet; the precision syringe; and weighing instruments. The glass capillary pipet is formed from a precision bore glass capillary tube. The pipet typically comprises a fire blown bulb and a tubular portion fire drawn to a fine point. Fluid is precisely metered by aspirating liquid through the tube into the bulb to a predetermined level indicated by an etched mark. The fluid may then be dispensed by blowing air through the tube.

The micro-pipet typically comprises a cylinder and a spring loaded piston. The travel of the piston is precisely determined by a threaded stop. The distance the piston travels within the cylinder and the diameter of the cylinder define a precise volume. The fluid is aspirated into and dispensed from the micro-pipet in precise quantities by movement of the piston within the cylinder.

The precision syringe generally comprises a precisely manufactured plunger and cylinder with accurately positioned metering marks. The fluid is introduced into and dispensed from the syringe by movement of the plunger between the marks.

Weighing techniques for dispensing fluids often simply involve weighing a quantity of fluid. The density of the fluid may then be used to determine the fluid volume.

Exemplary automatic metering and dispensing systems include the precision syringe pump; the peristaltic pump; and the high performance liquid chromatography (HPLC) metering valve. The precision syringe pump generally comprises a precision ground piston located within a precision bore cylinder. The piston is moved within the cylinder in precise increments by a stepping motor.

The peristaltic pump comprises an elastomeric tube which is sequentially pinched by a series of rollers. Often the tube is placed inside a semi-circular channel and the rollers mounted on the outer edge of a disc driven by a stepping motor. The movement of the rollers against the tubing produces peristaltic movement of the fluid.

The HPLC metering valve comprises a defined length of precision inner diameter tubing. The fluid is introduced into the define volume of the tubing with the valve in a first position and then dispensed from the tubing when the valve is placed in a second position.

All of the above metering and dispensing systems have the disadvantage that the volumes dispensed are relatively large. Furthermore, these systems are also relatively slow, inefficient and comprise precision fitted components which are particularly susceptible to wear.

The printing of reagent fluids is frequently required in the manufacture of chemical assay test strips. Selected reagents are printed in a desired configuration on strips of filter paper. The strips may then be used as a disposable diagnostic tool to determine the presence or absence of a variety of chemical components.

Generally, to perform a chemical assay with a test strip, the strip is exposed to a fluid or a series of fluids to be tested, such as blood, serum or urine. In some instances, the strip is rinsed and processed with additional reagents prior to being interpreted. The precise interpretation depends on the type of chemical reactions involved, but it may be as simple as visually inspecting the test strip for a particular color change.

The manufacture of test strips generally involves either a manufacturing process or a blotting process. The blotting process is the simplest manufacturing method and permits most reagents to be applied without modification. A disadvantage of this process is that it is difficult to blot the fluids onto the test strip with precision.

The printing process will often involve any of three well known methods: silk screening; gravure; and transfer printing. The silk screening of reagents generally involves producing a screen by photographic methods in the desired configuration for each reagent to be printed. The screen is exposed under light to a preselected pattern and then developed. The areas of the screen which are not exposed to light, when developed, become porous. However, the areas of the screen which have been exposed to light remain relatively nonporous. The screen is then secured in a frame and the test strip placed below. The desired

reagent fluid, specially prepared to have a high viscosity, is spread over the top side of the screen. The reagent passes through the porous areas of the screen and onto the test strip. The test strip is then subjected to a drying process, specific to each reagent. Once the test strip is dry, it may be printed again using a different screen, pattern and reagent.

The gravure method of printing reagents comprises coating a metal surface with a light sensitive polymer. The polymer is exposed to light in the desired predetermined pattern. When developed, the polymer creates hydrophilic and hydrophobic regions. The reagent is specially prepared such that when applied to the metal it will adhere only to the hydrophilic regions. After the specially prepared reagent is applied, the test strip is pressed against the metal and the reagent is transferred from the metal to the test strip.

The transfer printing method comprises transferring the reagents from a die to the test strip in the desired pattern. The die is made with the appropriate pattern on its surface and then coated with the desired, specially prepared reagent. A rubber stamp mechanism is pressed against the die to transfer the reagent in the desired pattern from the die to the rubber stamp. The rubber stamp is then pressed against the test strip to transfer the reagent, in the same pattern, to the test strip.

Each of the above-mentioned reagent printing techniques has significant disadvantages. The most common disadvantage is the requirement that the reagents must be specially prepared. Additionally, if a variety of reagents are to be printed onto a single test strip, the strip must be carefully aligned prior to each printing. This alignment procedure increases the cost and decreases the throughput of the printing process. Moreover, a special die or screen must be produced for each pattern to be printed. A further disadvantage arises in that the above printing methods are unable to place reproduceable minute quantities of reagent on the test strip.

It is an object of the present invention to provide a printing and dispensing method and apparatus which avoids these disadvantages.

SUMMARY OF THE PRESENT INVENTION

The present invention is directed to a reagent dispensing and printing apparatus and method, wherein the apparatus comprises a transducer operative to eject a substantially uniform quantity of reagent in a precise predetermined direction.

According to one preferred embodiment of the present invention used in dispensing reagent fluids, a jetting tube is concentrically located with a piezoelectric transducer. The jetting tube comprises an orifice at one end and a reagent receiving aperture at the other end. The receiving end of the jetting tube is connected to a filter which is in turn connected to a reservoir containing a selected reagent. A jetting control unit supplies an electrical pulse of short duration to the transducer in response to a command issued by a computer. The electrical pulse causes the volume defined by the jetting tube to expand by an amount sufficient to intake a small quantity of reagent fluid from the reservoir. At the end of the pulse duration, the transducer de-expands propelling a small quantity of the reagent fluid through the orifice and into a fluid recepticle. If desired, additional droplets may be deposited in the recepticle or the recepticle aligned with an additional jetting tube for receiving an additional reagent fluid.

An additional preferred embodiment of the present invention may be used for printing reagent fluids onto a print medium. In this embodiment, the jetting tube is aligned with the printing medium such that the propelled droplet impacts a precise position on the medium. The jetting tube or print medium may then be repositioned and another droplet expelled from the jetting tube. The process may be repeated until a desired configuration of the reagent fluid is printed on the medium.

One advantage of the present invention is that precise minute quantities of reagent fluid may be dispensed or printed in a reproducible manner. Additionally, the method and apparatus may be used to emit droplets of fluids having a wide range of reagent fluid viscosities and surface tensions. The reagents do not in general have to be specially adapted for use with the present invention.

The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic representation of a first preferred embodiment of the present invention showing the use of multiple jetting heads to meter and dispense reagent fluid.

FIGURE 2a is a perspective view of a first preferred embodiment of the jetting head of the present invention.

FIGURE 2b is a cut-away perspective view of the preferred embodiment of Fig. 2a taken along lines 2b-2b with the contact pins removed.

FIGURE 2c is a sectional representation of the preferred embodiment of Fig. 2a taken along lines 2c-2c.

FIGURE 2d is a sectional representation of the preferred embodiment of Fig. 2c taken along lines 2d-2d.

FIGURE 2e is a sectional representation of the jetting tube and transducer of the preferred embodiment of Fig. 2b taken along lines 2e-2e.

FIGURE 3 is a schematic representation of a second preferred embodiment operating in the drop on demand mode as a reagent printing system.

FIGURE 4 is a schematic representation of a third preferred embodiment operating in the continuous mode as a reagent printing system.

FIGURE 5a is a schematic representation of a portion of the jetting head control unit showing the LED strobe circuit.

FIGURE 5b is a schematic representation of a portion of the jetting head control unit showing the high voltage power supply circuit.

FIGURE 5c is a schematic representation of a portion of the jetting head control unit showing the print control circuit.

FIGURE 5d is a schematic representation of a portion of the jetting head control unit showing a portion of the print pulse generator.

FIGURE 5e is a schematic representation of a portion of the jetting head control unit showing an additional portion of the pulse generator.

FIGURE 6a is a perspective view of a second preferred embodiment of the jetting head of the present invention.

FIGURE 6b is an exploded view of the preferred embodiment of Fig. 6a.

FIGURE 7 is a sectional representation of a third preferred embodiment of the jetting head of the present invention.

FIGURE 8 is a sectional view of a symmetrical portion of a fourth preferred embodiment of the jetting head of the present invention.

FIGURE 9 is a graph of the drop mass of the emitted droplets as a function of emission frequency for several fluid viscosities.

FIGURE 10 is a graph of the velocity of the emitted droplets as a function of frequency for several fluid viscosities.

FIGURE 11 is a graph of the total weight of fluid emitted as a function of the number of emitted droplets for a given fluid.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Turning now to the drawings, Fig. 1 shows a schematic representation of a first preferred embodiment of a reagent dispensing system generally represented as reference numeral 30. The dispensing system 30 comprises a plurality of reagent fluid reservoirs 200, a plurality of filters 300, a plurality of reagent jetting heads 400, a plurality of jetting head control units 500, an interface unit 600, a computer 700, transportation unit 902, a plurality of fluid mixing cells 904 and a detection station 906.

The reservoir 200 holds a selected quantity of reagent fluid for dispensing. The reservoir 200 is maintained at atmospheric pressure by suitable means such as an atmospheric vent. The reagent fluid is transferred from the reservoir 200 through the filter 300 to the reagent jetting head 400. The filter 300 is placed between the reservoir 200 and the jetting head 400 to ensure that any particular foreign matter in the reagent fluid is trapped before entering the jetting head 400.

The plurality of jetting heads 400 and the detection station 906 define a processing path. Each jetting head 400, which is described in detail below, ejects uniformly sized droplets 2 of reagent fluid. The droplets 2 are propelled, with controlled velocity and direction, towards a selecting mixing cell 904 positioned along

the processing path by the transportation unit 902. The mixing cells 904 are comprised of non-reactive material and function as minute holding tanks for the dispensed reagent fluid.

The plurality of jetting heads 400, shown in Fig. 1, are positioned sequentially along the processing path. Alternately, some or all of the plurality of jetting heads 400 may be positioned with respect to the transportation unit 902 such that the heads 400 direct the droplets 2 into a selected mixing cell 902 simultaneously.

The jetting heads 400 and the transportation unit 902 are controlled by the computer 700. The computer 700 issues commands to an interface unit 600 which is electrically connected to the transportation unit 902 and to the jetting head control unit 500. The interface unit 600 is of conventional design and is used to control the transfer of information between the computer 700 and the jetting control unit 500. The interface unit 600 is also used to control the transfer of information between the computer 700 and the transportation unit 902.

A first embodiment of the reagent jetting head is shown in Figs. 2a - 2e and generally represented by numeral 400. The jetting head 400 comprises a two piece symmetrical housing 402, 404. The housing 402, 404, when assembled, is adapted to form an orifice aperture 406, an air vent and reagent supply channel 410 and a transducer chamber 403, shown in Fig. 4b. Four screws 408, adapted to respective housing screw apertures 416, hold the housing 402, 404 in an assembled configuration.

The jetting head 400 further comprises a jetting tube 432, a piezo-electric transducer 434 and a reagent fluid supply tube 430. The jetting tube 432 defines a tapered orifice 433 at one end and a fluid receiving aperture 431 at the other end for expelling and receiving fluid, respectively. The piezo-electric transducer 434 is cylindrically shaped and secured concentrically about the mid-region of the jetting tube 432 with epoxy or other suitable means.

The piezo-electric transducer 434, shown in Fig. 2e, defines a first and second end and comprises a section of cylindrically shaped piezeo-electric material 435. An inner nickel electrode 437 covers the inner surface of the cylinder 435. The electrode 437 wraps around the first end of the cylinder 435 a sufficient distance to enable electrical connection external to the cylinder 435.

A second nickel electrode 436 covers the majority of the outer surface of the cylinder 435. The second electrode is electrically isolated from the first electrode 437 by an air gap at the face of the second end of the cylinder 435 and by an air gap on the outer surface of the cylinder 435 near the first end. When an electrical pulse is applied to the first and second electrodes 437, 436 a voltage potential is developed radially across the transducer material 435. The voltage potential causes the radial dimensions of the transducer 435 to change, which causes the volume defined by the transducer 434 to also change.

The jetting tube 432 is positioned in the transducer chamber 403 such that the receiving end 431 extends beyond the rearward end of the transducer 434. The receiving end 431 of the jetting tube 432 is inserted into one end of a reagent supply tube 430. The supply tube 430 is sealingly held to the jetting tube 432 by concentric teeth 412 formed by the housing sections 402, 404. The teeth 412 not only seal the supply tube 430 to the jetting tube 432, but, also, seal the supply tube 430 to the housing 402, 404.

The second end of the supply type 430 passes through the channel 410 and into a reagent reservoir 200. The reservoir 200 contains the reagent fluid to be dispensed by the jetting head 400. As the reagent fluid is dispensed, air is supplied to the reservoir 200 through the channel 410 to prevent the creation of a vacuum in the reservoir 200. The reservoir 200 is releasably attached to the housing 402, 404 and held in place by frictional forces. A reservoir cap 202 is flexibly attached to the reservoir 200 and adapted such that the cap 202 may be used to secure the opening in the reservoir 200 when the reservoir 200 is disengaged from the housing 402, 404.

The position of the jetting tube 432 defines the horizontal plane of the jetting head 400. The jetting tube 432 and the transducer 434 are held in a pre-defined vertical relationship with respect to the housing 402, 404 by means of two upper vertical alignment pins 418 and two lower vertical alignment pins 418. The two upper vertical alignment pins 418 extend horizontally from the housing section 402 into the transducer chamber 403. Similarly, the two lower vertical alignment pins 418 extend horizontally from the housing section 404 into the transducer chamber 403. Each vertical alignment pin 418 is formed integrally with the respective housing sections 402, 404.

The jetting tube 432 and the transducer 434 are held in a predefined horizontal relationship with respect to the housing 402, 404 by means of four horizontal alignment pins 424. Two of the horizontal alignment pins 424 extend horizontally from the housing section 402 approximately midway into the transducer chamber 403. Similarly, two of the horizontal alignment pins 424 extend horizontally from the housing section 404 approximately midway into the transducing chamber 403. Each horizontal alignment pin 424 is formed integrally with the respective housing section 402, 404. The alignment pins 418, 424, sealing teeth 412 and orifice aperture 406 are aligned and adapted to hold the jetting tube 432 and transducer 434 such

that the orifice 433 of the jetting tube 432 extends into the orifice aperture 406.

An electrical transducer activation pulse is supplied to the piezo-electric transducer 434 from the jetting head control unit 500 by means of two contact pins 422. A quantity of fluid will be dispensed from the jetting tube for each applied activation pulse. The activation pulse can be produced by a variety of conventional circuits or commercially available units. Therefore a detailed description of such a circuit will not be provided. However, a circuit for producing a series of activation pulses is provided in the description of the printing embodiment below. Due to the dif fering constraints involved in dispensing and printing, the circuit in the printing embodiment is not required to produce only a single pulse. However, one skilled in the art could, if desired, modify the circuit to produce a single pulse on demand for use in the dispensing embodiment.

Each contact pin 422 defines an enlarged head 423 which is adapted to contact the respective first and second electrodes 437, 436 located on the outer surface of the transducer 434. Two contact pin holders 414, integral with the housing 402, 404, are positioned to hold the respective contact pins 422 under the pin heads 423 such that each pin head 423 electrically engages the appropriate electrode 437, 436 of the transducer 434. Two contact pin engaging posts 420 extend from the housing 402, 404 opposite the contact pin holders 414 to engage and hold the contact pins 422 against the contact pin holders 414. The ends of the contact pins 422 opposite the pin heads 423 extend through the housing 402, 404 by means of contact pin apertures 421. Since the housing sections 402, 404 are formed symmetrically to one another, the contact pins 422 may be optionally attached above the transducer 434.

In operation, the reservoir 200 containing reagent fluid is fastened to the jetting head 400 such that the fluid supply tube 430 extends into the reagent fluid. The filter 300 may be fitted to the free end of the supply tube 430 or positioned inside the reservoir 200. Air is supplied through the channel 410 around the supply tube 430 to prevent the reservoir 200 from falling below atmospheric pressure. The air is prevented from entering around the supply tube 430 and into the transducer chamber 403 by the seal created between the sealing teeth 412 and the supply tube 430. The jetting tube 432 may be primed by slightly pressurizing the reservoir 200 to cause the reagent fluid to travel through the supply tube 430 and into the jetting tube 432. Once primed, the fluid is prevented from substantially withdrawing from the jetting tube 432 by the surface tension of the reagent fluid at the orifice 433.

The transducer activation pulse is conducted to the contact pins 422 of the jetting head 400. The contact pins 422 communicate the high voltage pulse to the electrodes 437, 436 of the transducer 434 with polarity such that the concentrically mounted transducer 434 expands. The rate of expansion is controlled by the rise time of the high voltage pulse which is preset to generate a rapid expansion. The expansion of the transducer 434 causes the jetting tube 432, which is epoxied to the transducer 434, to also expand. The expansion of the tube 432 generates an acoustic expansion wave interior to the tube 432 which travels axially towards the orifice 433 and towards the fluid receiving aperture 431. When the expansion wave reaches the orifice 433, the reagent fluid is partially drawn inwardly. However, the surface tension of the fluid acts to inhibit substantial inward fluid movement.

When the expansion wave reaches the end 431 of the tube 432, the expansion wave is reflected and becomes a compression wave which travels towards the center of the piezo-electric tube 434. The high voltage pulse width is adapted such that when the reflected compression wave is beneath the piezo-electric tube 434, the high voltage pulse falls, resulting in a de-expansion of the transducer 434 and the jetting tube 432. This action adds to the existing acoustic compression wave in the interior of the jetting tube 432. The enhanced compression wave travels toward the ori fice causing reagent fluid to be-dispensed from the tube 432. The fluid is propelled from the orifice 433 as a small droplet 2 and deposited in the selected mixing cell 904 positioned by the transportation unit 902. One droplet 2 is dispensed for each transducer activation pulse. This mode of dispensing is referred to as the drop on demand mode.

In some instances, the droplet 2 may be accompanied by at least one smaller satelite droplet. However, even if satelite droplets are present, the volume and velocity of the reagent droplets 2 are highly reproduceable. This reproduceability allows for precise dispensing of uniform, controllably sized droplets 2 of reagent fluid into the mixing cell 904.

The droplets 2 of reagents impact the mixing cell 904 with sufficient force and volume to cause fluidic mixing of the reagents. Once the desired amounts of the selected reagents are deposited in the selected mixing cell 904, mixing cell 904 is transported to the detection station 906 where the mixed reagents may be extracted for use or analyzed for assay results.

The dispensing system 30 provides numerous advantages based upon the ability of the reagent jetting head 400 to rapidly and reproduceably eject uniform quantities of a wide range of reagents. The reaction times of some chemical processes are dependent upon the volume of the reagents used. The ability of the dispensing system 30 to dispense such minute amounts of reagents thereby reduces the processing time

of certain chemical assays. Furthermore, some chemical assays require a wide range of dilution ratios. Many conventional dispensing systems are unable to dispense the reagents in volume small enough to make the desired assay practical. The dispensing system of the present invention overcomes this disadvantage.

In addition to dispensing reagent fluids, certain embodiments may be used for precision printing of reagents onto a printing medium such as filter paper to produce an assay test strip. A printing system 10 using the present invention is represented in Fig. 3. Structure similar in form and function to structure described above will be designated by like reference numerals. The printing system 10 comprises a reagent fluid reservoir 200, a filter 300, a reagent jetting head 400, a jetting head control unit 500, an interface 600, a computer 700, and an x-y plotter 800.

The x-y plotter 800 is a commercially available pen plotter, mechanically modified in a conventional manner such that the pen is replaced with the jetting head 400. The general operation and structure of the plotter 800 will not be described in detail. The plotter 800 accepts commands from the computer 700 thru a standard RS-232 serial interface contained within the interface unit 600. The plotter 800 processes the commands and produces control signals to drive an x-axis motor (not shown) and a y-axis motor (not shown). The x-axis motor is used to position the jetting head 400 and the y-axis motor is used to position a drum (not shown) to which the printing target 1 is attached.

The plotter 800 produces a pen down signal PENDN. This signal is applied to the control unit 500 and indicates that the plotter 800 is ready to begin a printing operation.

The control unit 500 also receives control signals from the interface unit 600. These signals include signals HIGHER*, LOWER* to control the magnitude of the pulse applied to the transducer 434; a reset signal RST to reset the control unit 500; and a series of print signals PRT*. The generation of these signals will not be described in detail since their production is performed by the conventional interface unit 600.

The jetting head 400 and fluid supply system 200, 300 are initialized and operate substantially as described above. The jetting head control unit 500, shown in Figs. 5a - 5e comprises a print control circuit 510, a pulse generator 530, a high voltage supply 540, and a strobe pulse generator 560. The control unit 500 also comprises a power supply. However, since the power supply is of conventional design it will not be shown or described in detail.

The print control circuit 510 receives the pen down signal PENDN from the plotter 800 and comprises a transistor Q100, a one-shot circuit U100, two NAND-gates U101, U102, a line decoder multiplexer U107 and four inverters U103-U106. The pen down signal PENDN is applied to the base of the transistor Q100 by resistors R100, R101 and diode D100. The emitter of transistor Q100 is tied to ground and the collector is connected to the +5 volt supply by resistor R102.

The one-shot U100 comprises inputs A, B and an output Q. The B input of the one-shot U100 is connected to the collector of the transistor Q100 and the A input is tied to ground. The time period of the pulse produced by the one-shot U100 is determined by a resistor R104, a variable resistor R105 and a capacitor C100. The output Q of the one-shot U100 is combined with the collector output of the transistor Q100 by the NAND-gate U101 and then inverted by the NAND-gate U102. The circuit is operative to produce an adjustable delay in the application of the pen down signal PENDN to the control unit 500.

The line decoder U107 is circuited to function as a 3 input AND-gate. The output of the NAND-gate U102 is applied to the first input of the decoder U107; the print signal line PRT* comprising a series of pulses from the interface unit 600 is applied to the second input; and a jetting head ON/OFF signal from switch S1 is applied to the third input. The inverter U106 inverts the output of the line decoder U107 to generate the print control signal PRT* and the inverters U103-U105 invert the control signals LOWER*, HIGHER*, and RST signals, respectively.

The high voltage supply 540, shown in Fig. 5b, provides +175 volts DC to produce a maximum pulse of +150 volts peak to peak at the reagent jetting head 400. The high voltage supply 540 comprises differential amplifier U12 and transistors Q1, Q2, Q13, Q14. A stable reference voltage of -2.5 volts DC is produced at the junction of a reservoir R13, connected to the -15 volt supply, and a diode CR6, connected to ground. The reference voltage is combined with a resistor R14 to produce an adjustable, stable voltage reference for the amplifer U12. The reference voltage is applied to the inverting input of the amplifier U12 through a resistor R11. The noninverting input of the amplifier U12 is connected to ground by a resistor R12. The amplifier U12, in combination with a feedback resistor R10, produces an output signal proportional to the difference of the voltage reference signal and the ground potential.

The output of the amplifier U12 is applied to the base of the transistor Q2 whose collector is connected to the +15 volt supply. The signal produced at the emitter of the transistor Q2 is applied to the base of the transistor Q1 through resistors R8, R6, R5, a transformer L1 and diodes CR4, CR2, CR1. The emitter of the transistor Q1 is connected to ground and the collector is connected to the +15 voltage supply through the

transformer L1. A diode CR3 connects the collector of the transistor Q1 to the junction of the resistor R5 and the diode CR4. The transistor Q1 is biased for proper operation by resistors R7, R6, R5. The resistor R7 and a capacitor C22 connect the junction of the resistor R8, R6 to the +15 voltage supply.

The transistor Q1 and the transformer L1 form a "flyback" blocking oscillator. Any increase in current supplied by the transistor Q1 produces an increase in energy transferred through the secondary winding of the transformer L1 and diode CR5. Therefore, an increase in current supplied by the transistor Q1 results in an increase in power available to the high voltage output. The diodes CR1-CR4 form a "Baker clamp" which prevents transistor Q1 from saturating. The clamp thereby avoids transistor storage time.

The diode CR5 is connected to a multiple pi filter formed by the inductors L3, L2, capacitors C24, C21, C41 and resistors R29. The multiple pi filter attenuates ripple and switching spikes in the signal supplied to the transistor Q13 which produces the high voltage output V+ +. A resistor R64 connects the base of the transistor Q13 to the emitter and to the resistor U29. The base is also connected to the collector of the transistor Q14 by a resistor R65. The base of the transistor Q14 is connected to the +15 volt supply by a resistor R67 and to ground by a resistor R66. The emitter of the transistor Q13 provides a signal HV SENSE which is fed back to the inverting input of the amplifier U12 through a resistor R9. The high voltage output V+ + is produced at the collector of the transistor Q13. The proper biasing of the transistor Q13 is provided by resistor R64 and the biasing circuit comprising the transistor Q14, resistors R67, R66, R65.

The pulse generator 530, shown in Figs. 5d, 5e, comprises an opto-isolator U18, a one-shot U23, a digital to analog (D/A) converter U30 and two binary counters U24, U25. The pulse generator 530 accepts control signals PRT*, LOWER*, HIGHER*, RST and produces the activation pulse which is applied to the transducer 434. In normal operation, the PRT* control signal is supplied to the opto-isolator U18 by a jumper JMP between contact points E5, E6. The opto-isolator U18 is of conventional design and comprises a light emitting diode (LED) circuit and a photo-element circuit. A resistor R15 operates as the load resistor for the LED circuit of the isolator and a capacitor C25 suppresses transient noise on the voltage supply to the isolator U18. The output of the isolator U18 is applied to one input of the one-shot U23 whose time constant is adjustably determined by resistors R38, R25 and a capacitor C30. The pulse from the non-inverting output of the one-shot U23 is fed to the base of a transistor Q9. A resistor R39 sets the approximate base current of the transistor Q9 which is used as a level shifter for converting the CMOS signal level to the +15 volt DC signal level.

The control of the rise and fall rates of the pulse generator 530 is accomplished by directing a pair of current source transistors Q11, Q12 to charge and discharge a capacitor C57. The transistor Q11 is operative as a source of current and the transistor Q12 is operative as a sink for current. A transistor Q10 controls the level of the current by applying an appropriate bias current through a resistor R56 to the base of the transistor Q11. The biasing of the transistors Q11, Q12 is critical to the proper rise and fall rates. Therefore precision voltage references CR13, CR15 are used to provide respective bias reference voltages. A temperature compensation network is formed from zener diodes CR14, CR16 and resistors R55, R54 to maintain stable operation of the transistors Q11, Q12, respectively. The variable resistors R49, R52 may be used to adjust the fall time and rise time, respectively, of the output pulse applied to the reagent jetting head 400. A plurality of resistors R45, R46, R47, R48, R49, R51, R52, R53, R56, R57, R58 are used to properly bias the transistor Q10, Q11, Q12 and capacitors C55, C60 are circuited to maintain stability of the circuit.

The impedance of the output stage of the rise and fall circuitry Q10, Q11, Q12 is very high. With such a high impedance, circuit elements attached to the capacitor C57 could affect the linearity of the rise and fall time constants. Therefore, an FET input operational amplifier U32 is used as an impedance interface. The amplifier U32 is configured in the noninverting mode and circuited with capacitors C58, C59 for stability.

The output of the amplifier U32 is applied to an inverting amplifier U31 by means of a resistor R62. The amplifier U31 inverts and conditions the pulse control signal with the aid of resistors R59, R60. Resistors R61, R63, connected to the -15 voltage supply, provide a means for adjusting the DC level offset of the amplifier U31 output signal. Capacitors C51, C52 are connected to enhance the performance and stability of the circuit.

The output of the amplifier U31 is applied by means of a resistor R41 to the positive voltage reference signal input REF(+) of the D/A converter U30. The negative voltage reference signal input REF(-) is tied to ground by a resistor R40. The D/A converter U30 produces output signals IOUT, IOUT* which are proportional to the difference between the positive and nega tive voltage reference signal inputs REF(+), REF(-). Capacitors C48, C49, C50 are connected to the D/A converter U30 to enhance stability.

The D/A converter outputs IOUT, IOUT* are also proportional to an 8-bit binary value applied to inputs B1-B8. The binary value is supplied by the counters U24, U25 which are controlled by the function signals LOWER*, HIGHER* and RST. The LOWER* signal and the HIGHER* signals are applied to the count up and

count down inputs CU, CD of the counter U24 by means of opto-isolators U19, U20. The carry and borrow outputs CY, BR of the counter U24 are connected with the count up and count down inputs CU, CD of the counter U25. The reset inputs RST of both counters U24, U25 receive the RST signal by means of an opto-isolator U21. Resistors R16, R17, R18 are used as load resistors for the LED circuits of the isolators U19, U20, U21 and capacitors C26, C27, C28 are used to enhance the stability of the isolator circuits.

The counters U24, U25 may optionally be preloaded to the selected 8-bit binary value through input lines TP0-TP7. The input lines TP0-TP7 are normally biased to the logical high signal state by resistive network U22. The selected binary value is loaded into the counters U24, U25 by pulling the respective inputs TP0-TP7 low and applying an external, active low, load signal EXT LOAD to pin TP8. The load signal pin TP8 is connected to the load inputs LOAD of the counters U24, U25 and conditioned by a clipping circuit comprised of diodes CR9, CR10 and a pull-up resistor of the resistor network U22.

The noninverted and the inverted outputs IOUT, IOUT* are connected to the inverting and noninverting inputs of a differential amplifier U29. The output of the amplifier U29 is fed back to the invert ing input by a resistor R50. The amplifier U29 converts the current output of the D/A converter U30 to a voltage output. Capacitors C56, C47 are provided to enhance circuit stability.

The output of the amplifier U29 is applied to the noninverting input of the amplifier U28. The output of the amplifier U28 is fed back to the inverting input by means of a capacitor C46 and a resistor R37. The inverting input is also connected to ground by a resistor R36. To enhance the frequency response of the amplifier U28, a resistor R43 and a capacitor C54 are connected between the frequency compensation input FC and ground. An adjustable DC offset is provided by connecting the output offset inputs OF, OF with a variable resistor R42. The wiper of the resistor R42 is connected to the high voltage power supply output V+ +.

The output of the amplifier U28 is also connected to the base of a transistor Q4 and through diodes CR11, CR12 to the base of a transistor Q7. The transistor Q4, Q7, Q3 and resistors R30-R35 form an output circuit capable of driving high capacitive loads at high slew rates and wide bandwidth. The variable resistor R31 may be used to set the maximum current through the bias network R30, R33 by measuring the voltage drop across resistor R35.

The strobe generator 560 produces a strobe pulse and comprises transistors Q101-Q105 and a one-shot circuit U108. The strobe intensity is determined by the circuit comprising the transistors Q101-Q104 and resistors R109-R115. The circuit is connected to the anode of the LED 900 and receives two inputs from the interface unit 600 to produce four levels of light intensity in the LED 900.

The activation aand duration of activation of the LED 900 is determined by the one-shot U108 and the transistor Q105. The one-shot U108 comprises inputs A, B and an output Q. The strobe signal STROBE is applied to the B input from the interface unit 600. The duration of the one-shot U108 output pulse is controlled by the adjustable RC network R107, R108. The output Q is applied to the base of the transistor Q105 by resistor R108. The collector of the transistor Q105 is connected to the cathode of the LED 900 to draw current through the LED 900.

The computer 700, control unit 500 and plotter 800 must be initialized. The initialization of the computer 700 and the plotter 800 will not be discussed since these units are of conventional design and operation.

To initialize the jetting head control unit 500, the computer 700 directs the interface unit 600 to issue a reset command. The reset signal RST is conducted to the control unit 500 whereupon the counters U24, U25 are cleared. The computer 700 then retrieves from its memory, or by conventional operator input, the desired digital setting for the D/A converter. This setting may also be calculated from data and may be tailored to specific sizes of jetting heads 400 or reagent fluids. The computer 700 then issues a series of commands, through the interface unit 600, to increment or decrement the counters U24, U25 to correspond to the desired binary setting. If the command directs that the counters are to be raised, then the HIGHER* signal is applied through the opto-isolator U20 to the count up CU input of the counter U24. Similarly, if the command directs that the counters are to be lowered then the LOWER* signal is applied through the opto-isolator U19 to the count down CD input of the counter U24. Since the carry and borrow outputs CY, BR of the counter U24 are connected to the count up and count down inputs CU, CD, respectively, of the counter U25, the digital setting applied to the D/A converter U30 may range from 0 to 255. Alternately, the counters U24, U25 could be initialized to a desired setting by loading the binary value on the lines TP0-TP7 and strobing the EXT LOAD line.

Once the control unit 500 and the plotter 800 are initialized, the printing cycle may begin. The computer 700 issues a command to the interface unit 600 to produce the series of PRT* signal pulses. The computer 700 then commands the plotter 800 to print, for example, a line along a selected path. The plotter 800 positions the jetting head 400 and target 1 and issues the pen down signal PENDN. The signal is delayed by the print control circuit 510 to ensure that the target 1 is properly positioned. At the expiration of the

delay, the signal is ANDed with the closed enable switch S1 and the series of print pulses PRT'. The result of the AND operation is the application of the PRT' pulses to the pulse generator circuit 530.

The PRT' signal is applied through the jumper JMP to the opto-isolator U18 and then to the one-shot U23. The one-shot U23 produces a pulse signal which is then converted from CMOS signal levels to the 15 volt DC signal level by the transistor Q9. The rise and fall circuitry comprising Q10, Q11, Q12 converts the square wave pulse into a pulse having the rise and fall characteristics preset by the resistors R49, R52. The conditioned pulse is then amplified by the amplifier U32 and applied to the amplifier U31.

The amplifier U31 converts the polarity of the conditioned pulse to that acceptable by the D/A converter U30 and supplies an adjustable DC offset. The DC offset is used to counteract possible distortion attributable to the amplifier U31. The distortion arises in that, for the amplifier U31 to be adequately responsive, a small degree of current must flow through the resistor R41. This current creates an offset condition at the output of the amplifier U29 which is then scaled by the D/A converter U30 in correspondence with the binary data. The resistor R63 allows a small amount of current to be applied to the amplifier U31 to control the offset voltage attributable to the current flowing through the resistor R41.

The D/A converter U30 scales the difference between the inputs REF(+), REF(-) using the binary data supplied to input lines B1-B8 to produce a current output pulse IOUT and a current inverted output pulse IOUT'. The two outputs IOUT, IOUT' are fed to the amplifier U29 which convert the current outputs into a single voltage output. The scaled, conditioned pulse is then applied to the output circuit comprising the amplifier U28 and the transistors Q3, Q4, Q5, Q6, Q7. The circuit produces a high voltage pulse with the aforementioned rise and fall characteristics to drive the piezo-electric transducer 434.

The high voltage pulse is applied to the transducer 434 and causes a droplet 2 of fluid to be propelled onto the target 1. Since the pen down signal PENDN is still applied, additional droplets 2 are produced from the jetting head 400. The plotter 800 moves the jetting head 400 and target 1 along the desired path during the emission of the droplets 2 to produce the desired printed line. When the printing is complete, the plotter 800 removes the pen down signal PENDN and the droplet emission stops. Of course it should be understood that dots, circles and the like could be produced by appropriate positioning of the target 1 and jetting head 400.

The size and uniformity of the droplets 2, as well as the presence of any satelite droplets, may be observed with the aid of the scope 950 and the LED 900. The scope 950 and the LED 900 are positioned such that the droplets 2 pass between the scope 950 and the LED 900 and within the focal range of the scope 950. The strobe pulse when applied to the LED 900 causes the LED 900 to momentarily flash. The timing of the activation and the width of the pulse may be adjusted such that the flash occurs when the fluid, expelled in response to the high voltage pulse, is between the scope 950 and the LED 900. The dispensed quantity of fluid may then be observed in flight or at or near the momement of separation from the orifice 433. Corrections based on the observation may then be made to the system 10.

Since each droplet 2 is small in volume, the droplet 2 may be rapidly absorbed by the target 1, thereby allowing rapid and precise placement of a variety of reagents on the target 1 with reduced drying time and reduced potential of fluidity mixing. In addition, the ability to place small droplets 2 in a precise manner enables the target 1 to be printed in a high density matrix with a variety of reagents as isolated matrix elements.

In some printing applications, particularly when printing fluids of low viscosity and surface tension, it may be desirable to force the fluid through the jetting tube 432 under pressure and allow the vibrations produced by the transducer 434 to break the emitted fluid stream into precise droplets 2. Under this mode of printing, the emission of droplets 2 can not be stopped by cessation of the tranducers activation pulse. It is therefore necessary to prevent fluid emission by other means. One preferred means of momentarily stopping emission of the droplets is shown schematically in Fig. 4. In this arrangement, structure similar to structure represented in Fig. 3 in form and function, is represented by like reference numerals.

The arrangement, generally represented by the numeral 20, includes a closed reagent recirculation system comprising a normally close three way valve 970, a sump 960 and a recirculation pump 980. In the continuous mode, the reagent fluid is forced out the orifice 433 by hydraulic pressure and broken into a series of substantially uniform droplets 2 by movement of the transducer 434. A regulated, filtered air supply 100 is used to pressurize the reagent fluid reservoir 200. The reagent fluid within the reservoir 200 may optionally be agitated by a magnetic stirer unit 990. This is especially useful for reagent fluids comprising suspended particles.

The three-way valve 970 comprises a common channel, a normally open channel and a normally closed channel. The fluid is forced through the filter 300 and applied to the normally closed channel of the valve 970. When the normally closed channel is closed, the normally open channel of the valve 970 functions as a vent for the reagent jetting head 400. The common channel is connected to the reagent supply tube 430

of the jetting head 400. The reagent supply tube 430 is also connected to the sump 960.

In operation, the normally closed channel is opened by an appropriate signal supplied by the computer 700 which also closes the normally open channel. When the normally closed channel is opened, fluid is permitted to pass to the sump 960 and to the jetting head 400. The sump 960 collects the reagent fluid not transferred to the jetting head 400. The sump 960 supplies the collected fluid to the inlet side of the recirculating pump 980 which returns the fluid to the reservoir 200. The returned fluid is then mixed with the contents of the reservoir 200 and is available for recirculation.

When operating in the continuous mode, rather than interrupt the continuous stream of print pulses to the jetting head 400, the printing may be momentarily stopped by closing the normally closed channel of the valve 970. The closing of the normally closed channel stops the flow of reagent fluid to the jetting head 400 and allows the jetting head 400 to vent to atmospheric pressure. With the fluid supply blocked, the transducer 434 is unable to expel further droplets 2. Thus, if positioning of the target 1 by the plotter 800 requires a longer time interval than the time between droplet 2 emission, the computer 700 may close the normally closed channel of the valve 970. The plotter 800 may then position the target 1 or position a new target 1 as desired.

When printing, the active ingredient of the reagent is tailored to achieve a desired concentration per unit area on the target 1. However, to a certain extent the final concentration per unit area can be adjusted by varying the density of the droplets 2 printed on the target 1. The preferred embodiment is particularly well suited to this application due to its ability to print precise, discrete pels of reagent.

A second preferred embodiment of the jetting head is illustrated in Figs. 6a-6b and is generally represented as 400'. The jetting head 400' comprises housing formed into three sections 401', 402', 403'. The housing section 403' comprises a recessed region which forms the reagent fluid reservoir 200' when the housing section 403' is positioned against housing section 402'.

The jetting head 400' further comprises a piezo-electric transducer 434' and a reagent jetting tube 432' similar to those of the first embodiment. The jetting head 400' and the transducer 434' are most clearly shown in Fig. 6b. The jetting tube 432' defines an orifice 433' at one end and a reagent fluid receiving aperture 431' at the other end. The transducer 434' is mounted to the jetting tube 432' concentrically about the mid-region of the tube 432' with epoxy.

The transducer 434' and the jetting tube 432' are positioned in channels 420', 418', 416' located in the housing sections 402', 401'. The channel 416' comprises a plurality of sealing teeth 412' operative to engage and seal against the fluid receiving end 431' of the jetting tube 432'. The channel 416' is connected to the reagent fluid supply channel 430'. The supply channel 430' is connected with the fluid reservoir 200' by means of an aperture 431' through the housing section 402', shown in Fig. 6b.

The reservoir 200' comprises a flexible reservoir lining 201' adapted to contain the reagent fluid. The lining 201' comprises one aperture which is connected to the housing 402' to allow the fluid to pass from the lining 201'. A vent (not shown), located in the housing 403', allows the space between the reservoir 200' and the lining 201' to be vented or pressurized. A filter 300' is positioned within the aperture 202' to trap unwanted particulate foreign matter.

Electrical pulses are supplied to the transducer 434' by means of two contact pins 422'. The pins 422' are inserted through respective apertures 419' of the housing section 402' and respective apertures 421' of the housing section 403'. Two thin electrically conductive strips 410', 411', shown in Fig. 6b, are used to connect the transducer 434' with the contact pins 422'. A protective shield 405' extends from the housing position 403' to partially isolate the protruding portions of the contact pins 422'.

The function and operation of the jetting head 400' is similar to that of the jetting head 400 and therefore will not be discussed in detail. The collapsible inner lining 201' of the reservoir 200 allows the jetting tube 432' to be primed by pressurizing the reservoir 200' through the vent 205'. Once primed, the jetting head 400' may be used as described above in reference to the jetting head 400.

The jetting head 400' provides an advantage in that the entire fluidic system is contained in one housing. Such containment allows for fast and efficient replacement of the jetting heads without fluid contamination problems.

A third preferred embodiment of the jetting head is shown in Fig. 7 and generally represented as 400". The jetting head 400" comprises a housing 403", a reagent fluid supply tube 406", a piezo-electric transducer 434" and an orifice plate 404". The housing 403" defines a conically shaped fluid chamber 432". An orifice plate 404", defining an orifice 433", is fastened to the housing 403" such that the orifice 433" is located at or near the apex of the conical fluid chamber 432".

The fluid feed tube 406" is attached to the housing 403" and defines a supply channel 430". The supply channel 430" is in fluid communication with the fluid chamber 432" by means of a connecting channel 431". The base of the fluid chamber 432" is formed by the disc-shaped transducer 434". The transducer 434" is

held in position by a hold down plate 402" attached to the housing 403". The electrical connec tions to the transducer 434" are of conventional design and are therefore not shown. The housing 403" further comprises a threaded aperture 406" for mounting the jetting head 400".

The jetting head 400" operates in a manner similar to the jetting heads described above. However, in this jetting head the transducer 434" is normally disk shaped. When the electrical pulse is applied, the transducer 434" bends slightly, thereby altering the volume of the conically shaped jetting chamber 432". The change in volume of the chamber 432" causes the expulsion of fluid through the orifice 433" and the intake of fluid through the supply channel 430" as described in reference to the jetting head 400.

A fourth preferred embodiment of the jetting head is shown in Fig. 8 and is generally represented as 400" . The jetting head 400" is very similar in form and function to the jetting head 400 and will not be described in detail. The jetting head 400" comprises two symmetrical housing sections. The sections may be connected together by means of apertures 409" and screws, not shown. When assembled, the housing sections 404", 402" form a T-shaped supply channel 410" .

In operation, the jetting head 400" functions in a manner similar to the jetting head 400. The jetting head 400" is especially suited for use in the continuous mode, but may also be used in the drop on demand mode. In the continuous mode, the fluid is circulated continuously through the supply channel 430" allowing the jetting tube 432" to withdraw as much fluid as required.

By way of illustrating and with no limitations intended the following information is given to further illustrate the above described embodiments. The computer 700 is an IBM Corporation Personal Computer with 640 kbytes of RAM memory. The interface unit 600 is a Burr Brown interface unit model number PC 20001. The plotter 800 is manufactured by Houston Instrument as model number DMP-40. Communication between the plotter 800 and the interface unit 600 is performed through a standard asynchronous serial communication port.

The electrical pulse applied to the jetting head 400 to activate the transducer 434 comprises a rise time of approximately 5 usecs, a fall time of approximately 5 usecs and a pulse width of approximately 35 usecs. When the transducer 434 is operated in the drop on demand mode, the voltage potential of the pulse is 60 volts plus or minus 10 volts and the pulse frequency can be up to 4 khz. When the transducer 434 is operated in the continuous mode, the voltage potential of the pulse is 30 volts plus or minus 10 volts and the pulse frequency can be up to 10 khz.

The jetting tube 432 is manufactured from a pyrex glass tube and measures .027 inches outside diameter and .020 inches inside diameter. The tube is drawn to a closed taper in an electric furnace. The tapered end is then cut and ground to a desired orifice opening of .002 to .004 inches in diameter. The tube is cut to a final length of .945 inches in the case of the dispenser embodiment and ultrasonically cleaned in acetone. After being cleaned and dried the large end of the tube is fire polished. If desired, the orifice end of the tube may receive a coating, such as a hydrophobic polymer, to enhance droplet separation from the tube.

The supply tube 430 is formed from .023 inch inside diameter and .38 inch outside diameter polyethylene tubing produced by Intramedic Corp. as model number #14 170 11B. During assembly, one end of the tubing is stretched over a warm tapered mandrel. The stretched end of the supply tube 430 is then inserted over the large fire polished end of the jetting tube 432. The assembly is then cleaned and baked in a circulating air oven at 50°C. for 10 minutes.

The transducer 434 was purchased from Vernitron of Cleveland, Ohio as model number PZT-5H. The electrodes 437, 436 are comprised of nickel and are separated from each other on the outer surface of the transducer by approximately .030 inches. The jetting tube 432 is inserted into the cylindrical piezo-electric tube 434 and secured with epoxy manufactured by Epoxy Technology of Bellenca, Massachusetts as model number 301. The epoxy is applied at the junction of the tube 432 and transducer 434 with a synnge. The epoxy flows along the tube 432 inside the transducer 434 by capillary action. The assembly is then baked in a circulating air oven at 65°C. for one hour to cure the epoxy.

The contact pins 422 are secured to one of the housing sections 402, 404 with a drop of epoxy. The transducer jetting tube 434, 432 is placed in the housing such that the orifice end 433 of the tube 432 protrudes approximately .030 inches from the housing 403, 404. A drop of silver epoxy is placed between each contact pin 422 and the transducer 434 to ensure a secure electrical connection. Epoxy is also applied to the junction of the housing 402, 404 and supply tube 430. The other section of the housing 402, 404 is then screwed into place.

The periphery of the housing 402, 404 is sealed with a capillary sealer such as cyclohexanone. Epoxy is then added around each contact pin 422 and around the orifice end 433. The assembly is then baked in a circulating air oven at 65°C. for one hour.

The filter 300 is formed from a polyester mesh with 30 um pores and positioned in a polypropylene

housing. The air pressure supplied to the reservoir 200 during continuous printing operations is regulated at approximately 10 to 30 psi.

The reagents used have the following characteristics:

Printing (drop on demand mode):
Fluid viscosity range: 1 - 30 centipoises
Fluid surface tension: 20 - 70 dyne/cm
Printing (continuous mode):
Fluid viscosity range: up to 50 centipoises
Fluid surface tension: not measured
Dispensing (drop on demand mode):
Fluid viscosity range: 2 - 30 centipoises
Fluid surface tension: 20 - 70 dyne/cm

A measure of the performance and selected operating characteristics for a typical jetting head are presented in Figs. 9-11. Fig. 9 is a graph of the mass of a droplet as a function of droplet emission frequency for three fluids. The viscosity of the fluids were 1, 5 and 24 centipoise and the transducer excitation pulse width was 35 microseconds. As shown in Fig. 9, the higher fluid viscosity results in a more stable operating performance of the jetting head. Fig. 10 is a graph of droplet velocity as a function of droplet emission frequency for fluid viscosities of 1, 5 and 24 centipoise. The log of the total fluid weight as a function of the log of the number of droplets emitted is shown in Fig. 11. The fluid used has a viscosity of 2 centipoise, a surface tension of 20 dynes/cm, and a density of .8 grams/cc. The transducer excitation pulse was 80 volts and the excitation frequency was approximately 711 Hz.

Some blood typing reagents and some allergen reagents have very low viscosities and surface tensions. Although in some cases viscosity modifiers, such as glycerol, dextran, glucose, and the like, may be added to increase the viscosity, a few reagents are adversely affected by such modifiers.

Developing stable and reproduceable demand mode jetting is difficult with very low viscosities. Although droplet emission can be established at some fundamental frequencies, the droplets dispensed may have small satelite droplets which reduce the accuracy for metering and dispensing applications. However, even with the satelite drops, sufficient reagent is adequately delivered for most print applications without a substantial decrease in print quality.

Glycerin may be used as a viscosity modifier to improve jetting reliability and to prevent obstruction of the orifice arising from evaporation of the reagent fluid components. Glycerin has been found especially beneficial for those reagents containing particulate material. The evaporation of the fluid component results in a concentration of glycerin located at the orifice. The plug of glycerin substantially prevents further evaporation of the reagent fluid. During the next activation cycle of the transducer, the plug of glycerin is expelled from the orifice.

When operating in the dispensing mode the volume of the droplets can be varied to substantially uniformly contain from 100 pico-liters to 1 micro-liter. The droplets can be produced at a rate of approximately 1 khz to 8 khz. When operating in the printing mode the size of the pel made by each droplet measures approximately .001-.012 inches in diameter.

A copy of the program used in the computer 700 for a printing operation is attached hereto as Appendix A. The values, manufacturer and manufacturing part number of the circuit components of the jetting control unit 500 are substantially as follows:

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
R39,45-48,57, 58	RES.10KOHM¼WATT5%C.F.	
R66	RES.150OHM¼WATT5%C.F.	
R3	RES.15KOHM¼WATT5%C.F.	
R34	RES.16KOHM¼WATT5%C.F.	
R50	RES.2.4KOHM¼WATT1%M.F.	DALE RL079242G
R13,23,36,40, 41	RES.2.4KOHM¼WATT5%C.F.	
R56	RES.20KOHM¼WATT5%C.F.	
R8	RES.2200HM¼WATT5%C.F.	
R6	RES.270HM1WATT5%C.C.	
R7,12,25	RES.2KOHM¼WATT5%C.F.	
R67	RES3.6KOHM¼WATT5%C.F.	
R51,53	RES.3.9KOHM¼WATT5%C.F.	
R29	RES.300KOHM¼WATT5%C.F.	
R61	RES.30KOHM¼WATT1%M.F.	DALE RL079303G
R15-18,26-28, 54,55,64	RES.4.7KOHM¼WATT5%C.F.	
R62	RES.45.3KOHM¼WATT1%M.F.	DALE RN55D4532F
R30,33	RES.470HM¼WATT5%C.F.	
R21	RES.4700HM¼WATT5%C.F.	
R19	RES.47KOHM¼WATT5%C.F.	
R35	RES.5100HM¼WATT5%C.F.	
R43	RES.5.2KOHM¼WATT5%C.F.	
R60	RES.7.5KOHM¼WATT5%C.F.	
R37	RES.75KOHM¼WATT5%C.F.	
R9	RES.76KOHM¼WATT1%M.F.	DALE RN60D7662F
R11	RES.8200HM¼WATT5%C.F.	
U2,11,14,16,22	RES.DIP NETWRK.47KOHM	CT9 761-1R47K
C21,41,45	CAP.AXIALIMF@250VDC	MALLORY #TC56
C24	CAP.AXIAL220MF@250VDC	MALLORY LE2219250C7P3
C10	CAP.AXIAL ALUM ELEC. 4700 OMF@25VDC	MALLORY TCG472U025NIC
C1,2,3,55,60	CAP.RADIAL DIPPED TANT. 10MF@25VDC	KEMET T350E106M025AS
C53	CAP.RADIAL DIPPED TANT. 1MF@35VDC	KEMET T350A105K035AS
C36	CAP.RADIAL DIPPED TANT. 47MF@10VDC	KEMET T350E566MC10AS

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
C54	CAP.RADIAL SILV MICA 100PF300VDC	KAHGAN SD5101J301
C57	CAP.RADIAL SILV MICA 20PF300VDC	KAHGAN SP12200J301
C49	CAP. RADIAL SILV. MICA 39PF300VDC	KAHGAN SP12390J301
C39	CAP.RADIAL X7R MLC .015MF@50VDC	KEMET C315C102K1R5CA
C6	CAP.RADIAL X7R MLC .022MF@50VDC	KEMET C315C223K5R5CA
C30,35,37	CAP.RADIAL Z5U MLC .015MF@50VDC	KEMET C315C153K5R5CA
C4,7	CAP.RADIAL Z5U MLC .01MF@50VDC	KEMET C315C103K5R5CA
C4,5,6,9,11-19, 22,23,25-28 C31-34,37,42,43 47,48,50-52 C56,58,59	CAP.RADIAL Z5U MLC .22MF@50VDC	KEMET C322C224M5U5CA
C46	CAP.VARI.2-12PF.	JOHANSEN #9626
CR7,8,9,10, 11,12,17	DIODE SIL.	ITT.FAIRCHLD.1N4148
CR1,2,3,4	DIODE SIL.FAST	GENL.INST.EGP10D
CR5	DIODE SIL.FASTHIVOLT	GENL.INST.UF4007
CR6,13,15	DIODE SIL.REF.2,500VDC	NATL.SEMI-LM3852-2.5
CR14,16	DIODE SIL.ZENER3.8V.25WATT	MOTOROLA 1N4622A
U6,13,15,17	SWITCH 8 POSITION DIP	CTS 206-8
Q2,9,12	TRANSTOR.COMMON NPN	MOTOROLA 2N2222A
Q8,10,11	TRANSTOR.COMMON PNP	MOTOROLA 2N2907A
Q4	TRANSTOR.HIVOLTHIFREQ.NPN	MOTOROLA MPSU10
Q7	TRANSTOR.HIVOLTHIFREQ.PNP	MOTOROLA MPSU60
Q1	TRANSTOR.HIVOLTHIINPN	TI,MOTOROLATIP48
Q3,14	TRANSTOR.HIVOLTNPN2N3439	MOTOROLA 2N3439
Q13	TRANSTOR.HIVOLTPNP	MOTOROLA MJE5731
U5,27	IC 1-SHOT 74HC221	NATL.SEMI MM74HC221N
U23,26	IC 1-SHOT 74LS221	NATL.SEMI DM741S221N
U7-10	IC COMPARATOR 74HC688	NATL.SEMI MM74HC688N
U30	IC CONVERTER DAC0800	NATL.SEMI DAC0800LCN
U24,25	IC COUNTER 74HC193	NATL.SEMI MM74HC193N
U28	IC HI SLEW HI VOLT OP AMP	BURR-BROWN 3584JM
U1	IC HYBRID DC/DC CONVERTER	BURR-BROWN MODEL 724
U4	IC OC DRIVER SN7406	NATL.SEMI DM7406N
U3	IC OCTAL LATCH 74HC374	NATL. MM74HC374N
U12,29,31,32	IC OP AMP LF256	NATL.SEMI LF256H
U18,19,20,21	IC OPTO ISOLATOR	HEWLTT-PCKRD HCPL2300
R24,42,63	POT100KOHM½WATT10%	BOURNS 3622-1-104
R38,49,52	POT10KOHM½WATT10%	BOURNS 3622W-1-103
R20	POT25KOHM½WATT10%	BOURNS 3622W-1-253
R14,31	POT2KOHM½WATT10%	BOURNS 3622W-1-202

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
VRI	REGULATOR 5VDC	NATL.LM340T-5.0
R10	RES.1MEGOHM½WATT5%C.F.	
R2,4	RES.1.2KOHM½WATT5%C.F.	
R32	RES.1.6KOHM½WATT5%C.F.	
R44	RES.1.8KOHM½WATT5%C.F.	
R1	RES.10MEGOHM½WATT5%C.F.	
R5,R22	RES.100HM½WATT5%C.F.	
R65	RES.100KOHM½WATT5%C.F.	
R59	RES.10KOHM¼WATT1%M.F.	DALE RN55D1002F
R100	RES.270OHM	
R101,108	RES.470OHM	
R102,103 106,109,110	RES.1KOHM	
R104	RES.47000HM	
R105	POT.100KOHM	
R107	POT.10KOHM	
R111,113	RES.2200HM	
R112	RES.220HM	
R114,115	RES. 470HM	
C100	CAP.10MF035 VPC	
C108	CAP.10000 PF	
D100	DIODE	1N4148
Q100,105	TRANSTOR	2N2222
Q101,102	TRANSTOR	2N3906
Q103,104	TRANSTOR	2N3904
U100,U108	IC I-SHOT	74LS123
U103,104 105,106	IC INVERTOR	74LS04
U108	IC LINE DECODER	74LS138

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the transducer could be of a type other than piezo-electric such as magneto-strictive, electro-strictive, and electro-mechanical. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

APPENDIX

```
Reagent Jet Printer                                                    PAGE  1
Reagent Calibration                                                    07-14-86
                                                                       12:26:57
                                                  IBM Personal Computer BASIC Compiler V2.00
 Offset  Data    Source Line

 0030   0006   REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Calibration' $LINESIZE: 132
 0030   0006   'MODULE   - "REACAL"
 0030   0006   '
 0030   0006   'AUTHOR   - R. A. Enevold
 0030   0006   '
 0030   0006   'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
 0030   0006   'REVISION - 2.0 07-01-86 RAE MicroFab modifications
 0030   0006   '         - 1.0 02-11-86 RAE Creation of initial code
 0030   0006   '
 0030   0006   'SYSTEM   - This code can only be compiled by the BASCOM
 0030   0006   '           COMPILER, it will not run under the INTERPRETER!!
 0030   0006   '
 0030   0006   'DESCRIPTION:
 0030   0006   '       The reagent calibrate module presents a menu with 12 items arranged
 0030   0006   '       in 3 columns of 4 rows.  The arrow keys allow movement around the
 0030   0006   '       table, the + and - keys increment or decrement values in the first
 0030   0006   '       column, and the enter key executes commands in the third column.
 0030   0006   '       The second column is an array of ASCII strings representing reagent name,
 0030   0006   '       concentration, density, and viscosity.  The values entered in column one
 0030   0006   '       are drop frequency, pulse width, strobe delay, and nozzle number.
 0030   0006   '       The commands in the third column are start/stop, load, save, and exit.
 0030   0006   '
 0030   0006   'DATA DICTIONARY
 0030   0006   '       MENU%          Pointer to which menu item is active (0-11)
 0030   0006   '       MENU$(17,1)    Array for strings used to display the menu
 0030   0006   '       MENU(17,4)     Array for numbers in the menu display
 0030   0006   '       DIFF%          Differential to move MENU% at arrow key input
 0030   0006   '       TYPE%          Pointer set during main scan to direct action
 0030   0006   '       KEYBUF$        Storage for string input from menu display
 0030   0006   '       A$             Destination for single keystroke inputs
 0030   0006   '       FILE$          String where filename is built for reagent data file
 0030   0006   '       REAGNAME$      String where reagent name is stored
 0030   0006   '       RI             Row to display special graphics character in menu
 0030   0006   '       CI             Column to display special graphics character in menu
 0030   0006   '       MT             Special graphics character is read into here
 0030   0006   '       OLD.AMP.VALUE% Integer value for setting pulse amplitude
 0030   0006   '       DIG.VAL%       Value set to digital port 0 to inc/dec amplitude
 0030   0006   '
 0030   0006   SUB REAGENT.CALIBRATE STATIC
 0047   0006
 0047   0006           DIM MENU$(17,1),MENU(17,4)
 0048   01FE
 0048   01FE           GOSUB INITIALIZE:       'read init. values and set screen
 004E   01FE
 004E   01FE           WHILE TYPE% <> 1
 0059   0200
 0059   0200             TYPE% = 0
 0060   0200             A$ = ""
 006A   0204
 006A   0204             WHILE A$ = ""
 0079   0204               A$ = INKEY$
 0083   0204               IF ACTIVE% = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
 00AD   020A             WEND
 00B0   020A
```

```
Offset  Data    Source Line

00B0    020A            IF A$ = CHR$(13) THEN TYPE% = 1:            'execute (cr)
00CA    020A            IF A$ = "+" THEN TYPE% = 2:                 'increment variable
00E0    020A            IF A$ = "-" THEN TYPE% = 3:                 'decrement variable
00F6    020A            IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 4:  'up arrow key
011B    020A            IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 5:  'down arrow key
0140    020A            IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 6:  'left arrow key
0165    020A            IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 7:  'right arrow key
018A    020A            IF A$ > CHR$(47) AND A$ < CHR$(123) THEN TYPE% = 8:' ascii 0 - z
01C2    020A
01C2    020A            ON TYPE% GOSUB T1, T2, T3, T4, T5, T6, T7, T8
01DB    020A
01DB    020A          WEND
01DF    020A          TYPE% = 0
01E6    020A
01E6    020A          EXIT SUB
01EA    020A    REM $PAGE
```

```
 Offset  Data   Source Line

 01EA    0203   '********** SUBROUTINES FOR THIS MODULE **********
 01EA    0203
 01EA    0203   T1:             '(cr) execute command
                IF MENU1 < 12 THEN TYPE1 = 0:RETURN:    'exit to print menu, no action
 01EF    0208   ON MENU1 - 11 GOSUB T1A, T1B, T1C, T1D
 0205    020C   IF MENU1 < 15 THEN TYPE1 = 0
 021A    020C   RETURN
 022C    020C
 0230    020C
 0230    020C   T1A:            'start/stop drop flow
 0233    020C   IF MENU$(12,0) = "START" THEN GOSUB START.INX
 025A    020C   IF MENU$(12,0) = "STOP " THEN GOSUB STOP.INX
 027F    020C   MENU$(12,0) = TEMP$
 029A    0210   COLOR 0,7:GOSUB DISPMENU
 02AC    0210   RETURN
 02B0    0210
 02B0    0210   START.INX:
 02B5    0210   TEMP$ = "STOP "
 02BF    0210   CALL BOT.ON:          'in module PCI
 02CB    0210   LOCATE 17,71:COLOR 27,0:PRINT "PRINTING";
 02F1    0210   ACTIVE1 = 1
 02F8    0210   RETURN
 02FC    0210
 02FC    0210   STOP.INX:
 0301    0210   TEMP$ = "START"
 030B    0210   CALL BOT.OFF:         'in module PCI
 0317    0210   LOCATE 17,71:COLOR 15,0:PRINT "       ";
 033D    0210   ACTIVE1 = 0
 0344    0210   RETURN
 034B    0210
 034B    0210   T1B:            'load reagent profile
 034D    0210   IF MENU$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
 0391    0210
 0391    0210   GOSUB SEARCH
 0397    0210
 0397    0210   IF I1 < (READUP1 + 1) THEN GOTO FOUND
 03A8    0214   LOCATE 25,10-LEN(MENU$(6,1))/2:PRINT MENU$(6,1)" not Found";
 0404    0214   GOSUB ANYKEY:   'wait for a keyhit
 0408    0214   RETURN
 040E    0214
 040E    0214   FOUND:
 0413    0214   FILE$ = RIGHT$(STR$(I1),LEN(STR$(I1))-1) + "REA.RJP"
 0437    0218   OPEN FILE$ FOR INPUT AS #1:     'set pattern data file for read
 0448    0218   INPUT #1,MENU(0,0):     'read frequency
 0468    0218   INPUT #1,MENU(1,0):     'read amplitude
 0489    0218   INPUT #1,MENU(2,0):     'read stroke delay
 04AE    0218   INPUT #1,MENU(3,0):     'read pulse width
 04D1    0218   INPUT #1,MENU(4,0):     'read rise time
 04F4    0218   INPUT #1,MENU(5,0):     'read fall time
 0519    0218
 0519    0218   INPUT #1,MENU$(7,1):    'read concentration
 053B    0218   INPUT #1,MENU$(8,1):    'read density
 0561    0218   INPUT #1,MENU$(9,1):    'read viscosity
 0585    0218   INPUT #1,MENU$(10,1):   'read surface tension
 05A9    0218
```

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Reagent Calibration

```
 Offset  Data   Source Line

 0549    0218          CLOSE #1:       'done with data file
10 0580  0218
 0580    0218          OPEN "READEF.RJP" FOR OUTPUT AS #1
 0580    0218          PRINT #1,FILES:                 'save filename in default file
 05C2    0218          PRINT #1,MENUS(6,1):    'save the directory name as well
 05D2    0218          CLOSE #1
 05F4    0218          GOSUB DISP.PARMS:       'show all parameters
 05FB    0218          RETURN
15 0601  0218
 0605    0218
 0605    0218  T1C:            'save reagent profile
 060A    0218          IF MENUS(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
 064E    0218          OPEN "READIR.RJP" FOR INPUT AS #1
 065F    0218          INPUT #1,READIRX
20 0671  0218          CLOSE #1
 0678    0218          IF READIRX < 80 THEN GOTO SAVE.REA
 0687    0218          LOCATE 25,1:PRINT "Directory is Full (80 reagents max.)"
 06A1    0218          GOSUB ANYKEY:RETURN
 06AB    0218  SAVE.REA:
 06B0    0218          GOSUB SEARCH
25 06B6  0218          IF I% > READIRX THEN GOTO SAVEREAI
 06C7    0218          READIRX = I%
 06CE    0218          COLOR 15,0
 06DA    0218          LOCATE 25,1:PRINT MENUS(6,1);" already exists. Replace it with new values? ";
 070C    0218          A$ = ""
 0716    0218          WHILE A$ = ""
30 0725  0218                A$ = INKEY$
 072F    0218          WEND
 0732    0218          LOCATE 25,1:PRINT SPACE$(79);
 074F    0218          IF A$ = "Y" OR A$ = "y" THEN GOTO REPLACE
 0778    0218          RETURN
 077C    0218
35 077C  0218  SAVEREAI:
 0781    0218          KILL "READIR.OLD":      'delete old backup directory
 0788    0218          NAME "READIR.RJP" AS "READIR.OLD":      'save old directory
 07A2    0218          OPEN "READIR.OLD" FOR INPUT AS #1
 07A3    0218          OPEN "READIR.RJP" FOR OUTPUT AS #2:     'set up new dir
 07B5    0218
40 07B5  0218          INPUT #1,READIRX:       'read number of dir entries
 07C7    0218          READIRX = READIRX + 1:  'increase by 1
 07D0    0218          WRITE #2,READIRX:       'save in new directory
 07E1    0218
 07E1    0218          FOR I=1 TO READIRX - 1
 07FA    021C              LINE INPUT #1,A$:   'read entry from old dir
45 0807  021C              PRINT #2,A$:        'write entry in new directory
 0817    021C          NEXT I
 0832    0220
 0832    0220          CLOSE #1
 0839    0220
50 0839  0220          PRINT #2,MENUS(6,1):    'write new entry to new directory
 0858    0220          CLOSE #2:       'done with directory
 0862    0220
 0862    0220  REPLACE:
 0867    0220          FILES = RIGHT$(STR$(READIRX),LEN(STR$(READIRX))-1) + "REA.RJP"
 0888    0220
55
```

```
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  Reagent Jet Printer                                                                    PAGE  5
  Reagent Calibration                                                                    07-14-86
                                                                                         12:24:57
  Offset  Byte   Source Line                                    IBM Personal Computer BASIC Compiler V2.00

0888  0220          OPEN FILE$ FOR OUTPUT AS #1:   'create new pattern data file
088D  0220          WRITE #1,MENU(0,0):     'store frequency
0898  0220          WRITE #1,MENU(1,0):     'store amplitude
089C  0220          WRITE #1,MENU(2,0):     'store strobe delay
08F9  0220          WRITE #1,MENU(3,0):     'store pulse width
091E  0220          WRITE #1,MENU(4,0):     'store rise time
093F  0220          WRITE #1,MENU(5,0):     'store fall time
0962  0220
0962  0220          WRITE #1,MENU$(7,1):    'store concentration
0984  0220          WRITE #1,MENU$(8,1):    'store density
09A6  0220          WRITE #1,MENU$(9,1):    'store viscosity
09C8  0220          WRITE #1,MENU$(10,1):   'store surface tension
09EA  0220
09EA  0220          CLOSE #1:       'done with data file
09F1  0220
09F1  0220          OPEN "README.RJP" FOR OUTPUT AS #1
0A03  0220          PRINT #1,FILE$:                 'save filename in default file
0A13  0220          PRINT #1,MENU$(6,1):    'save the directory name as well
0A35  0220          CLOSE #1
0A3C  0220          RETURN
0A40  0220
0A40  0220    SEARCH:
0A45  0220          OPEN "README.RJP" FOR INPUT AS #1
0A56  0220          INPUT #1,README%:       'read number of patterns in dir
0A6B  0220          I% = 1:                 'set entry pointer
0A6F  0220
0A6F  0220    SLOOP:
0A74  0220          LINE INPUT #1,A$:       'read next pattern name from dir
0A81  0220          IF A$ = MENU$(6,1) THEN GOTO SEARCH.DONE:       'compare name with dir entry
0A95  0220          I% = I% + 1
0AAE  0220          IF I% < (README% + 1) THEN GOTO SLOOP:'check for done
0AC1  0220    SEARCH.DONE:
0AC6  0220          CLOSE #1
0AC9  0220          RETURN
0AD1  0220
0AD1  0220    T1%:          'return with no change to exit reagent calibrate
0AD6  0220          PRINT #3,"LM";
0AE6  0220          CLOSE #3:'      close com channel
0AEB  0220          RETURN
0AF1  0220
0AF1  0220    T2:           'process "+" key
0AF6  0220          IF MENU% > 5 THEN RETURN
0B05  0220          NEWTIME = TIMER
0B0F  0224          DELTATIME = NEWTIME - OLDTIME
0B1F  022C          OLDTIME = NEWTIME
0B29  022C          IF DELTATIME > 0.15 THEN MULT% = 1 ELSE MULT% = MULT% + 1
0B48  022E          IF MULT% > 100 THEN MULT% = 100
0B58  022E          MENU(MENU%,0) = MENU(MENU%,0) + MENU(MENU%,3) * MULT%:  'add increment
0B9F  022E          IF MENU(MENU%,0) > MENU(MENU%,1) THEN MENU(MENU%,0) = MENU(MENU%,1):    'check max value
0C06  022E          COLOR 15,1:GOSUB DISPMENU:RETURN:                       'show new value
0C1D  022E
0C1D  022E    T3:           'process "-" key
0C22  022E          IF MENU% > 5 THEN RETURN
0C31  022E          NEWTIME = TIMER
```

```
Offset  Data    Source Line

0C3B    022E            DELTATIME = KEYTIME - OLDTIME
0C4B    022E            OLDTIME = KEYTIME
0C55    022E            IF DELTATIME > 0.15 THEN MULTI = 1 ELSE MULTI = MULTI + 1
0C77    022E            IF MULTI > 100 THEN MULTI = 100
0C89    022E            MENU(MENUT,0) = MENU(MENUT,0) - MENU(MENUT,3) * MULTI:  'sub increment
0CCB    022E            IF MENU(MENUT,0) < MENU(MENUT,2) THEN MENU(MENUT,0) = MENU(MENUT,2):    'check min value
0D32    022E            COLOR 15,1:GOSUB DISPMENU:RETURN:                       'show new value
0D49    022E
0D49    022E    T4:             'process up arrow key
0D4E    022E            IF MENUT MOD 6 = 0 THEN RETURN:                 'in top row already
0D63    022E            DIFFT = -1:GOSUB MENUMENU:RETURN:       'move pointer up one
0D74    0230
0D74    0230    T5:             'process down arrow key
0D79    0230            IF MENUT MOD 6 = 5 THEN RETURN:                 'in bottom row already
0D8F    0230            DIFFT = 1:GOSUB MENUMENU:RETURN:                'move pointer down one
0DA0    0230
0DA0    0230    T6:             'process left arrow key
0DA5    0230            IF INT(MENUT / 6) = 0 THEN RETURN       'in left column already
0DC5    0230            DIFFT = -6:GOSUB MENUMENU:RETURN:       'move pointer one left
0DD6    0230
0DD6    0230    T7:             'process right arrow key
0DDB    0230            IF INT(MENUT / 6) = 2 THEN RETURN       'in right column already
0DFE    0230            DIFFT = 6:GOSUB MENUMENU:RETURN:                'move pointer one right
0E0F    0230
0E0F    0230    T8:             'input keys into KEYBUF$ until (cr) is entered
0E14    0230            IF MENUT > 10 THEN RETURN
0E23    0230            LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0E35    0230            KEYBUF$ = A$
0E3F    0234            WHILE A$ <> CHR$(13)
0E72    0234                    LOCATE 25,47:PRINT SPACE$(13);
0E8F    0234                    LOCATE 25,47:PRINT KEYBUF$;
0EA9    0234                    A$ = ""
0EB3    0234                    WHILE A$ = ""
0EC2    0234                            A$ = INKEY$
0ECC    0234                            IF ACTIVE1 = 1 AND DOGTIME < TIMER THEN GOSUB PEN.DOWN
0EF6    0234                    WEND
0EF9    0234                    IF A$ = CHR$(8) AND LEN(KEYBUF$) > 0 THEN KEYBUF$ = LEFT$(KEYBUF$,LEN(KEYBUF$)-1)
0F3B    0234                    IF A$ > CHR$(31) AND LEN(KEYBUF$) < 15 THEN KEYBUF$ = KEYBUF$ + A$
0F75    0234            WEND
0F79    0234
0F79    0234            IF MENUT > 5 THEN GOTO STORESTRING
0F88    0234
0F8B    0234            TEMP = VAL(KEYBUF$)     'temp has value of keys input
0F98    0238
0F98    0238            'round off temp according to step size in menu array
0F98    0238            TEMP = INT(TEMP / (MENU(MENUT,3)) + .5) * MENU(MENUT,3)
0FD1    0238
0FD1    0238            'test TEMP for maximum and minimum values in menu array
0FD1    0238            IF TEMP > MENU(MENUT,1) THEN TEMP = MENU(MENUT,1)
1019    0238            IF TEMP < MENU(MENUT,2) THEN TEMP = MENU(MENUT,2)
104F    0238
104F    0238            'insert new value into menu array and update screen
104F    0238            MENU(MENUT,0) = TEMP
1048    0238            LOCATE 25,30:PRINT SPACE$(40);
```

```
 Offset  Data    Source Line

 1068   0238          COLOR 0,7:GOSUB DISPMENU
 106A   0238          RETURN
 106E   0238
 106E   0238    SUBSTRING:
 10A3   0238          MENU$(MENUT,1) = KEYBUF$
 10BF   0238          LOCATE 25,20:PRINT SPACE$(40);
 10DC   0238          COLOR 0,7:GOSUB DISPMENU
 10EE   0238          RETURN
 10F2   0238
 10F2   0238    PEN.BOX:
 10F7   0238          DOWNTIME = TIMER + 1
 1107   0238          PRINT #3,"D";
 1117   0238          RETURN
 111B   0238
 111B   0238    ANYKEY:
 1120   0238          LOCATE 25,64:PRINT "Strike any key..";
 113A   0238          A$ = ""
 1144   0238          WHILE A$ = ""
 1153   0238                A$ = INKEY$
 115D   0238          WEND
 1160   0238          LOCATE 25,1:COLOR 15,0:PRINT SPACE$(79);:COLOR 15,1
 1196   0238          RETURN
 119A   0238
 119A   0238    NEWMENU: 'write old item in yellow, point to and highlight new item
 119F   0238          COLOR 14,0:GOSUB DISPMENU
 11B1   0238          MENUT = MENUT + DIFFT
 11BD   0238          IF MENUT = 11 THEN MENUT = 10
 11CF   0238          IF MENUT > 15 THEN MENUT = 15
 11E1   0238          COLOR 0,7:GOSUB DISPMENU:RETURN
 11F7   0238
 11F7   0238    INITIALIZE:
 11FC   0238          'change to second screen and display messages
 11FC   0238          SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,28:PRINT "Initializing Menu Display";
 1240   0238          LOCATE 12,33:PRINT "Please Wait..."
 125A   0238
 125A   0238          'initialize variables
 125A   0238
 125A   0238          ACTIVE% = 0:'   not printing
 1261   0238
 1261   0238          'initialize plotter com channel
 1261   0238
 1261   0238          OPEN "COM1:2400,N,8,2" AS #3
 1273   0238          PRINT #3,":UECS,EFV1,R";
 1283   0238
 1283   0238          'initialize digital port
 1283   0238          SCRI% = 4
 128A   023A          CALL DIGITAL.OUT(SCRI%)
 129A   023A          SCRI% = 0
 12A1   023A          CALL DIGITAL.OUT(SCRI%);        'pulse reset line to set amplitude to 0V.
 12B1   023A          SCRI% = 4
 12B8   023A          CALL DIGITAL.OUT(SCRI%)
 12C8   023A
 12C8   023A          'set hardware pulse width
 12C8   023A          CALL SET.DOT.WIDTH(5)    'in module PC1
```

```
Offset- Data   Source Line

1208  0232
1208  0232          'initialize menu arrays
1208  0232          RESTORE ARRDATA
1208  0232          FOR II=0 TO 17
1213  0232                READ MENU$(II,0),MENU$(II,1):
1233  0232                READ MENU(II,1),MENU(II,2),MENU(II,3),MENU(II,4)
137C  0232          NEXT II
138F  0232
138F  0232          'set default reagent values
138F  0232
138F  0232          MENU(0,0) = 2000:           'frequency
13A8  0232          MENU(1,0) = 8:              'amplitude
13C4  0232          MENU(2,0) = 1:              'strobe delay
13E0  0232          MENU(3,0) = 090:            'pulse width
13FC  0232          MENU(4,0) = 470:            'rise time
1418  0232          MENU(5,0) = 070:            'fall time
1436  0232
1436  0232          MENU(6,0) = 0:              'base
1452  0232          MENU(7,0) = 0:              'concentration
146E  0232          MENU(8,0) = 0:              'density
148A  0232          MENU(9,0) = 0:              'viscosity
14A6  0232          MENU(10,0) = 0:                     'surface tension
14C2  0232
14C2  0232          OLD.AMP.VALUE% = 0          'initial value of 0 volts
14C9  023E
14C9  023E          'change active displayed screen to first screen to draw and display parameters
14C9  023E
14C9  023E          SCREEN 0,0,0,1:CLS
14E6  023E
14E6  023E          COLOR 13:LOCATE 1,32:PRINT "REAGENT CALIBRATE";
1507  023E          COLOR 9
150E  023E          FOR I=2 TO 79
1518  023E                LOCATE 3,I:PRINT "B";:LOCATE 5,I:PRINT "B";:LOCATE 19,I:PRINT "B";
156F  023E          NEXT I
158A  023E          FOR I=4 TO 18
1594  023E                LOCATE I,1:PRINT "J";:LOCATE I,28:PRINT "s";:LOCATE I,69:PRINT "s";:LOCATE I,80:PRINT "J";
1608  023E          NEXT I
1626  023E          RESTORE TABLE
1628  023E          FOR I=1 TO 12
1637  023E                READ R1,C1,M1:LOCATE R1,C1:PRINT CHR$(M1);
166A  0244          NEXT I
1685  0244
1685  0244          'print three headings and instructions
1685  0244          COLOR 10,0
1691  0244          LOCATE 4,7:PRINT "DROP PARAMETERS";
16AB  0244          LOCATE 4,39:PRINT "REAGENT PARAMETERS"
16C5  0244          LOCATE 4,71:PRINT "COMMANDS";
16DF  0244
16DF  0244          COLOR 7:LOCATE 21,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
1729  0244          PRINT CHR$(32);CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
1768  0244          LOCATE 22,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
17BE  0244          COLOR 7:PRINT" to scroll current value up or down";
1702  0244          LOCATE 23,26:PRINT "Use ";:COLOR 15:PRINT "ENT";:COLOR 7:PRINT" to activate selection";
1814  0244
```

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Reagent Jet Printer                                                    PAGE  9
Reagent Calibration                                                    07-14-86
                                                                       12:26:57
                                                IBM Personal Computer BASIC Compiler V2.00

  Offset  Data   Source Line

  1814    0244   DISP.PARMS:
  1819    0244           'display 18 menu choices in yellow
  1819    0244
  1819    0244           COLOR 14,0
  1825    0244           FOR MENUI = 0 TO 17
  1829    0244                   GOSUB DISPMENU
  1831    0244           NEXT MENUI
  1841    0244
  1841    0244           'set for reagent name and highlight it
  1841    0244           MENUI = 6:COLOR 0,7
  1854    0244           GOSUB DISPMENU
  185A    0244
  185A    0244           SCREEN 0,0,0,0
  186F    0244           RETURN
  1873    0244   REM $PAGE
```

```
Offset  Byte   Source Line
 1873   0244   DISPMENU:
 1878   0244          LOCATE (MENUI MOD 6)*2+7,(INT(MENUI/6)*20+2)+15*INT(MENUI/12)
 1804   0244          PRINT MENUS(MENUI,0)
 18F2   0244          IF MENUI > 5 THEN GOTO SHOWSTRING:'     no value to display
 1901   0244          LOCATE (MENUI MOD 6)*2+7,MENU(MENUI,4)
 1933   0244          PRINT USING MENUS(MENUI,1);MENU(MENUI,0);
 1966   0244          IF MENUI > 2 THEN RETURN
 1975   0244          ON MENUI+1 GOSUB SET.FREQ, SET.AMP, SET.DELAY
 1986   0244          RETURN
 198A   0244   SHOWSTRING:
 198F   0244          IF MENUI > 10 THEN RETURN
 195E   0244          LOCATE (MENUI MOD 6)*2+7,48
 198A   0244          PRINT "                "
 19C7   0244          LOCATE (MENUI MOD 6)*2+7,48
 19E3   0244          PRINT MENUS(MENUI,1)
 1A02   0244          RETURN
 1A06   0244
 1A06   0244   SET.FREQ:
 1A0B   0244          TEMP = MENU(0,0)
 1A24   0244          CALL SET.DOT.RATE(TEMP):        'in module PCI
 1A34   0244          LED% = 3-INT((TEMP+500)/1000)
 1A57   0246          IF LED% < 0 THEN LED% = 0
 1A69   0246          SCR% = 4 + (LED% * 32):                 'set LED intensity
 1A89   0246          CALL DIGITAL.OUT(SCR%):                 'in module PCI
 1A99   0246          RETURN
 1A9D   0246
 1A9D   0246   SET.AMP:
 1AA2   0246          SCR% = CINT(MENU(MENUI,0) * 255 / 150):         'convert volts to binary number
 1ACB   0246          IF SCR% = OLD.AMP.VALUE% THEN RETURN
 1ADC   0246          TEMP% = SCR% - OLD.AMP.VALUE%:          'calculate delta
 1AEB   0248          OLD.AMP.VALUE% = SCR%:                  'update old value to current value
 1AEF   0248          DIG.VAL% = 8
 1AF6   024A          IF TEMP% < 0 THEN DIG.VAL% = 5
 1B08   024A          TEMP% = ABS(TEMP%)
 1B15   024A          FOR I% = 1 TO TEMP%
 1B22   024C                SCR% = DIG.VAL% + (32*LED%)
 1B3F   024C                CALL DIGITAL.OUT(SCR%):           'pulse higher or lower
 1B4F   024C                SCR% = 4 + (32 * LED%)
 1B6F   024C                CALL DIGITAL.OUT(SCR%):           'set port to normal
 1B7F   024C          NEXT I%
 1B91   024C          RETURN
 1B95   024C
 1B95   024C   SET.DELAY:
 1B9A   024C          TEMP = MENU(2,0)
 1BB6   024C          CALL SET.STROBE.DELAY(TEMP):    'in module PCI
 1BC6   024C          RETURN
 1BCA   024C
 1BCA   024C   REM $PASE
```

```
 Offset  Data    Source Line

  1BCA   024C    '************ DATA USED BY THIS MODULE ************
  1BCA   024C
  1BCA   024C    ARRDATA:
  1BCF   024C            DATA "Frequency              Hz",".",".",10000,1,1,16
  1BD1   024C            DATA "Amplitude              V ",".",".",150,0,1,19
  1BD3   024C            DATA "Strobe Delay           uS",".",".",.5,.5,16
  1BD5   024C            DATA "Pulse Width              ",".",".",1,1,19
  1BD7   024C            DATA "Rise Time                ",".",".",1,1,19
  1BD9   024C            DATA "Fall Time                ",".",".",1,1,19
  1BDB   024C            DATA "Name","",0,0,0,0
  1BDD   024C            DATA "Concentration","",0,0,0,0
  1BDF   024C            DATA "Density","",0,0,0,0
  1BE1   024C            DATA "Viscosity","",0,0,0,0
  1BE3   024C            DATA "Surface Tension","",0,0,0,0
  1BE5   024C            DATA "","",0,0,0,0
  1BE7   024C            DATA "START","",0,0,0,0
  1BE9   024C            DATA "LOAD","",0,0,0,0
  1BEB   024C            DATA "SAVE","",0,0,0,0
  1BED   024C            DATA "EXIT","",0,0,0,0
  1BEF   024C            DATA "","",0,0,0,0
  1BF1   024C            DATA "","",0,0,0,0
  1BF3   024C
  1BF3   024C    TABLE:
  1BF8   024C            DATA 3,1,218
  1BFA   024C            DATA 3,28,210
  1BFC   024C            DATA 3,69,210
  1BFE   024C            DATA 3,80,191
  1C00   024C            DATA 5,1,198
  1C02   024C            DATA 5,28,206
  1C04   024C            DATA 5,69,206
  1C06   024C            DATA 5,80,181
  1C08   024C            DATA 19,1,192
  1C0A   024C            DATA 19,28,208
  1C0C   024C            DATA 19,69,208
  1C0E   024C            DATA 19,80,217
  1C10   024C
  1C10   024C    END SUB
  1C17   024C
  1C17   024C
  23ED-  024C

 50426 Bytes Available
 43960 Bytes Free

      0 Warning Error(s)
      0 Severe  Error(s)
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030 0006 REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Entry/Modif
          ication'
0030 0006 'MODULE   - "PATENT" Pattern creation, modification, and filing
                    .
0030 0006 '
0030 0006 'AUTHOR   - N. A. Enevold
0030 0006 '
0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030 0006 '
0030 0006 'REVISION - 1.2 03-10-86 NAE Remove Mouse inputs
0030 0006 '           1.1 02-20-86 NAE Add 80 pattern limit to save
0030 0006 '           1.0 01-13-86 NAE Creation of initial code
0030 0006 '
0030 0006 'SYSTEM   - This code can only be compiled by the BASCOM
0030 0006 '           COMPILER, it will not run under the INTERPRETER!!
0030 0006 '
0030 0006 'DESCRIPTION:
0030 0006 '       This module allows the user to LOAD, SAVE, DIRectory, D
          RAW and
0030 0006 '       enter repeat count and other parameters for a pattern t
          o be printed.
0030 0006 '       The low-resolution graphics mode is selected and a menu
           is displayed
0030 0006 '       across the bottom of the screen.  Using arrow keys
0030 0006 '       point to the action to be taken and then invoke that ac
          tion with the
0030 0006 '       Enter key.  In the DRAW mode, another menu is
0030 0006 '       displayed which allows the user to select from LINE, RE
          CTangle,
0030 0006 '       Solid RECTangle, or CIRCle pattern elements.
0030 0006
0030 0006 'DATA DICTIONARY
0030 0006 '       SCNDAT%(50,5)     51 Row (Elements) by 6 Column array f
          or storing pattern elements
0030 0006 '       CURSOR%(9)        Storage for cursor graphics icon
0030 0006 '       MENU$(6)          Up to 7 menu names can be saved here
0030 0006 '       ELNUM%            Count of number of elements in a patt
          ern
0030 0006 '       X% Y%             Current location of graphics cursor
0030 0006 '       GRID              Value of one dot space on the screen
          (default is 0.005")
0030 0006 '       ROW% COL%         Location to print instructions
0030 0006 '       A$                Storage for single key-strokes or inp
          ut strings
0030 0006 '       MENUNUM           Which menu is being displayed (1 or 2
          )
0030 0006 '       ITEM              Pointer to which menu item is highlig
          hted (0 - 6)
0030 0006 '       REPEAT%           Number of times pattern is to be repe
          ated when printed
0030 0006 '       XOFF  YOFF        X and Y axis distance between the pri
          nting of repeated patterns
0030 0006 '       ROWSP COLSP       Row and Column spacing for printing m
          ultiple sets of patterns
```

Reagent Jet Printer
Pattern Entry/Modification

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data    Source Line
0030    0006    '       PATNUM%             -   Number of patterns stored in
the pattern directory PATDIR.RJP
0030    0006    '       DROW% DCOL%     Row and Column location to display di
rectory entrys
0030    0006    '       NAME$           Pattern name to be LOADed or SAVEd to
 directory
0030    0006    '       I% J%           Counters used to LOAD or SAVE the ele
ment data from/to pattern data file
0030    0006    '       FILE$           Name of pattern data file
0030    0006    '       TEMP%           Which type of element is being drawn.
  1 = Line   2 = Rectangle
0030    0006    '
 3 = Solid Rectangle  4 = Circle
0030    0006    '       FLAG%           Same as TEMP% above
0030    0006    '       STARTMSG$ ENDMSG$ Message display for startpoint and en
dpoint of element entry
0030    0006    '       X1% Y1%                 Starting cursor position for
element being drawn
0030    0006    '       DX% DY%                 Delta X and Y values used to
re-position cursor after arrow key
0030    0006    '       MAXITEM                 The highest number item in th
e current menu display
0030    0006    '       MS ME           Starting and ending X position of the
 menu highlighting blue box
0030    0006    '       RADIUS%                 The calculated radius of a ci
rcle to be displayed
0030    0006    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030  0006  SUB PATENTRY STATIC
0047  0006
0047  0006        WIDTH 40:SCREEN 1:CLS
005F  0006        DIM SCNDATI(50,5),CURSORI(9),MENU$(6)
0060  029A        ELNUMI = 0:II=0:YI=0:GRID = 0.005
007F  02A4
007F  02A4        LINE (0,0)-(6,6),,B
00A1  02A4        LINE (0,3)-(6,3),,B
00C5  02A4        LINE (3,0)-(3,6),,B
00E9  02A4        PRESET (3,3)
00F5  02A4        GET (0,0)-(6,6),CURSORI
0116  02A4        CLS
011D  02A4
011D  02A4        LINE (0,0)-(319,190),,B
0140  02A4
0140  02A4        RESTORE INSTRUC
0147  02A4        FOR I=1 TO 4
0151  02A4              READ ROWI,COLI,A$
0164  02AC              LOCATE ROWI,COLI:PRINT A$;
01B0  02AC        NEXT I
019B  02B0
019B  02B0  FIRST:
01A0  02B0        MENUNUM = 1
01AA  02B4        GOSUB SUBMENU
01B0  02B4
01B0  02B4        ON ITEM + 1 GOTO PATDIR, PATLOAD, PATSAVE, PATDRAW, REP
                  EAT, PATEXIT
01CD  02BB        GOTO FIRST
01D0  02BB
01D0  02BB  REPEAT:
01D5  02BB        GOSUB ITEMBOXERASE:     'erase blue box around DIR
01DB  02BB        LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
01FB  02BB        LOCATE 25,1:INPUT;"Enter Repeat Count ",REPEATI
021B  02BA        LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
0235  02BA        LOCATE 25,1:INPUT;"Enter X Axis Offset ",XOFF
0255  02BE        LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
0272  02BE        LOCATE 25,1:INPUT;"Enter Y Axis Offset ",YOFF
0292  02C2        GOTO FIRST
0296  02C2  PATEXIT:
029B  02C2        WIDTH 80:SCREEN 0:CLS
02B2  02C2        EXIT SUB
02B6  02C2  REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 02B6   02C2   PATDIR:                    'list directory of patterns
 02BB   02C2          GOSUB ITEMEOIERASE:     'erase blue box around DIR
 02C1   02C2          LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
 02DE   02C2          OPEN "PATDIR.RJP" FOR INPUT AS #1:      'open directory
                 file
 02EF   02C2          INPUT #1, PATNUM1:      'read number of patterns in dir
                ectory
 0301   02C4          LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 0326   02C4          I = 0:                          'set counter
 0330   02C4
 0330   02C4   DISLOOP:
 0335   02C4          I = I + 1:              'set for next value
 0344   02C4          IF I > PATNUM1 THEN GOTO DIREXIT:       'test for done
 035B   02C4          IF INT((I-1)/44) <> (I-1)/44 THEN GOTO SHOWNEXT
 0384   02C4          IF INT((I-1)/44) < 1 THEN GOTO SHOWNEXT
 03A9   02C4
 03A9   02C4          LOCATE 25,1:PRINT "More to Display. Continue ? (Y or N)
                ";
 03C3   02C4          GOSUB CORLOOP:  'wait for Y or N response
 03C9   02C4          IF A$ = "N" THEN GOTO DIREXIT:  'if N then don't contin
                ue
 03DC   02C4
 03DC   02C4          LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 0401   02C4
 0401   02C4   SHOWNEXT:
 0406   02C4          DROW1 = ((I - 1) MOD 22) + 2:   'calculate row for disp
                lay
 0422   02C6          DCOL1 = 4:                      'set column to 4
 0429   02C8          IF ((I - 1) MOD 44) > 21 THEN DCOL1 = 23:'reset colum
                if necessary
 044C   02C8
 044C   02C8          LINE INPUT #1, A$:      'read next name from directory
 0459   02C8          LOCATE DROW1,DCOL1:PRINT A$;    'PRINT NAME
 0475   02C8          GOTO DISLOOP
 0479   02C8
 0479   02C8   DIREXIT:
 047E   02C8          CLOSE #1:       'terminate access to PATDIR.RJP
 0485   02C8          GOTO FIRST
 0489   02C8
 0489   02C8   REM $PAGE
```

```
0489  02D2  PATLOAD:
048E  02D8        GOSUB ITEMSOIERASE:     'erase blue box around DIR
0494  02D8        OPEN "PATDIR.RJP" FOR INPUT AS #1
0495  02D8        INPUT #1,PATNUMI:       'read number of patterns in dir
0497  02D8        GOSUB GETNAME:          'prompt for and input pattern n
ame
049D  02D8        LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
04E2  02D8
04E2  02D8        GOSUB SEARCH
04E8  02D8
04E8  02D8        IF II < (PATNUMI + 1) THEN GOTO FOUND
04EB  02D8        LOCATE 10,16-(LEN(NAME$)/2):PRINT NAME$;" not Found";
04FC  02DE        LOCATE 12,14:PRINT "Strike Any Key"
0531  02DE        GOSUB ANYKEY:   'wait for a keyhit
0534  02DE        GOTO FIRST
0531  02DE
0535  02DE  FOUND:
0535  02DE        FILE$ = RIGHT$(STR$(II),LEN(STR$(II))-1) + "PAT.RJP"
055A  02DE        OPEN FILE$ FOR INPUT AS #1:     'set pattern data file
057E  02D2  for read
056F  02D2        INPUT #1,ELNUMI:        'read number of elements in pat
tern
05A1  02D2        INPUT #1,GRID:          'read grid size
05B3  02D2        INPUT #1,REPEATI:       'read repeat count
05C5  02D2        INPUT #1,IOFF:          'read x axis offset for repeat
05D7  02D2        INPUT #1,YOFF:          'read y axis offset for repeat
05E9  02D2
05E9  02D2        FOR II = 0 TO ELNUMI - 1
05F7  02D4            FOR JI = 0 TO 5
05FD  02D4                INPUT #1,SCREATI(II,JI):'read file into screen
array
0621  02D6            NEXT JI
0631  02D6        NEXT II
0643  02D6        CLOSE #1:       'done with data file
064A  02D6
064A  02D6        OPEN "PATDEF.RJP" FOR OUTPUT AS #1
065C  02D6        PRINT #1,FILE$:                 'save filename in defau
lt file
066C  02D6        PRINT #1,NAME$:                 'save the directory nam
e as well
067C  02D6        CLOSE #1
0683  02D6
0683  02D6        GOTO REDRAW
0687  02D6
0687  02D6  SEARCH:
068C  02D6        II = 1:                         'set entry pointer
0693  02D6  SLOOP:
0698  02D6        LINE INPUT #1,A$:       'read next pattern name from di
r
06A5  02D6        IF A$ = NAME$ THEN GOTO SEARCH.END:     'compare name w
ith dir entry
06B8  02D6        II = II + 1
06C1  02D6        IF II < (PATNUMI + 1) THEN GOTO SLOOP:'check for done
06D4  02D6  SEARCH.END:
```

```
Offset  Data    Source Line
 06D9   0224            CLOSE #1:       'not found so close file and display me
                ssage
 06E0   0226            RETURN
 06E4   02D6
 06E4   0226    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
06E4  02D6  PATSAVE:
06E9  02D6          GOSUB ITEMGOIERASE:      'erase blue box around DIR
06EF  02D6          IF ELNUM% = 0 THEN GOTO FIRST:  'no elements in pattern
06FE  02D6          OPEN "PATDIR.RJP" FOR INPUT AS #1
070F  02D6          INPUT #1,PATNUM%
0721  02D6          IF PATNUM% < 80 THEN GOTO SAVE.PAT:      'directory full
                    at 80 patterns
0730  02D6          CLOSE #1
0737  02D6          LOCATE 25,1:PRINT SPACE$(39);:           'erase bottom l
                    ine
0754  02D6          LOCATE 25,1:PRINT "Directory is full (80 patterns max)"
                    ;
076E  02D6          GOSUB ANYKEY:GOTO FIRST
0778  02D6    SAVE.PAT:
077D  02D6          GOSUB GETNAME:  'prompt for and get pattern name
0783  02D6          GOSUB SEARCH
0789  02D6          IF I% > PATNUM% THEN GOTO ADD.NEW.PATTERN
079A  02D6          LINE (1,1)-(318,189),0,BF:       'erase graphics tablet
07BF  02D6          LOCATE 10,13-(LEN(NAME$)/2):PRINT NAME$;" already exist
                    s.";
07F4  02D6          LOCATE 12,15:PRINT "Replace it?"
080E  02D6          PATNUM% = I%
0815  02D6          A$ = ""
081F  02D6          WHILE A$ = ""
082E  02D6                A$ = INKEY$
083B  02D6          WEND
083B  02D6          IF A$ = "Y" OR A$ = "y" THEN GOTO SAVE.PATTERN
0864  02D6          GOTO FIRST
086B  02D6
0868  02D6    ADD.NEW.PATTERN:
086D  02D6          KILL "PATDIR.OLD":       'delete old backup directory
0874  02D6          NAME "PATDIR.RJP" AS "PATDIR.OLD":       'save old direc
                    tory
087E  02D6          OPEN "PATDIR.OLD" FOR INPUT AS #1
088F  02D6          OPEN "PATDIR.RJP" FOR OUTPUT AS #2:      'set up new dir
08A1  02D6          INPUT #1,PATNUM%:        'read number of dir entries
08B3  02D6          PATNUM% = PATNUM% + 1:   'increase by 1
08BC  02D6          WRITE #2,PATNUM%:        'save in new directory
08CD  02D6          FOR I=1 TO PATNUM% - 1
08E6  02DA              LINE INPUT #1,A$:    'read entry from old dir
08F3  02DA              PRINT #2,A$:         'write entry in new directory
0903  02DA          NEXT I
091E  02DA          PRINT #2,NAME$:          'write new entry to new directo
                    ry
092E  02DA          CLOSE #1:CLOSE #2:       'done with directory
093C  02DA    SAVE.PATTERN:
0941  02DA          FILE$ = RIGHT$(STR$(PATNUM%),LEN(STR$(PATNUM%))-1) + ".P
                    AT.RJP"
0965  02DA          OPEN FILE$ FOR OUTPUT AS #1:     'create new pattern dat
                    a file
0977  02DA          WRITE #1,ELNUM%:         'store number of elements
0988  02DA          WRITE #1,GRID:           'store grid dimension
0998  02DA          WRITE #1,REPEAT%:        'store repeat count
09A9  02DA          WRITE #1,IOFF:           'store x axis offset for repeat
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 09B9   02DA          WRITE #1,YOFF:          'store y axis offset for repeat
 09C9   02DA          FOR IZ = 0 TO ELEMENT - 1
 09D7   02DC              FOR JZ = 0 TO 5
 09DD   02DC                  WRITE #1,SENDATA(IZ,JZ):        'write screen a
rray to file
 0A00   02DC              NEXT JZ
 0A10   02DC          NEXT IZ
 0A22   02DC          CLOSE #1:       'done with data file
 0A29   02DC          OPEN "PATDEF.RIP" FOR OUTPUT AS #1
 0A3B   02DC          PRINT #1,FILE$:                 'save filename in defau
lt file
 0A4B   02DC          PRINT #1,NAME$:                 'save the directory nam
e as well
 0A5B   02DC          CLOSE #1
 0A62   02DC          GOTO FIRST
 0A66   02DC      REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0A6e 02DC  PATCRAW:
0A83 02DC          GOSUB ITEMBOIERASE
0A71 02DC          LINE (1,1)-(318,189),0,BF:      'Erase graphics tablet
0A96 02DC
0A96 02DC  NEXTEL:
0A9E 02DC          MENUNUM = 2
0AA5 02DC          GOSUB SUBMENU
0AAB 02DC
0AAB 02DC          ON ITEM + 1 GOTO ALINE, RECT, SRECT, ACIRCLE, REDRAW, B
                   ACKUP
0ACB 02DC          GOTO NEXTEL
0ACB 02DC
0ACB 02DC  BACKUP:
0AD0 02DC          GOSUB ITEMBOIERASE
0AD6 02DC          GOTO FIRST
0ADA 02DC
0ADA 02DC  ALINE:
0ADF 02DC          TEMP1 = 1
0AE6 02DE          STARTMSG$ = "STARTING ENDPOINT"
0AF0 02E2          ENDMSG$ = "ENDING ENDPOINT  "
0AFA 02E6          GOTO ENTERELEMENT
0AFE 02E6
0AFE 02E6  RECT:
0B03 02E6          TEMP1 = 2
0B0A 02E6          GOTO RECTMSG
0B0E 02E6
0B0E 02E6  SRECT:
0B13 02E6          TEMP1 = 3
0B1A 02E6  RECTMSG:
0B1F 02E6          STARTMSG$ = "STARTING CORNER"
0B29 02E6          ENDMSG$ = "ENDING CORNER  "
0B33 02E6          GOTO ENTERELEMENT
0B37 02E6
0B37 02E6  ACIRCLE:
0B3C 02E6          TEMP1 = 4
0B43 02E6          STARTMSG$ = "CENTER OF CIRCLE"
0B4D 02E6          ENDMSG$ = "POINT ON CIRCLE  "
0B57 02E6
0B57 02E6  ENTERELEMENT:
0B5C 02E6          GOSUB ITEMBOIERASE
0B62 02E6          FLAG%=0
0B69 02EB          LOCATE 25,1:PRINT SPACE$(39);
0B86 02EB          LOCATE 25,1:PRINT STARTMSG$;
0BA0 02EB          GOSUB DISPCURSOR
0BA6 02EB  FINDSTART:
0BAB 02EB          GOSUB MOUSEACT
0BB1 02EB          IF A$ = CHR$(27) THEN GOTO ABORT
0BC8 02EB          IF A$ = CHR$(13) THEN GOTO SETSTART
0BCF 02EB          GOSUB CURSORMOVE
0BE5 02EB          GOTO FINDSTART
0BEE 02EB  ABORT:
0BED 02EB          GOSUB PLACECURSOR
0BF3 02EB          GOTO NEXTEL
0BF7 02EB
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
 0BF7  02EB  SETSTART:
 0BFC  02EB          LOCATE 25,1:PRINT ENGMSG$;
 0C16  02EB          FLAGI = TEMPI:XII = XI:YII = YI
 0C2B  02EC          IF FLAGI = 4 THEN PSET (XII+4,YII+4)
 0C35  02EC  FINDEND:
 0C5A  02EC          GOSUB MOUSEACT
 0C60  02EC          IF A$ = CHR$(27) THEN GOTO CANCELEL
 0C77  02EC          IF A$ = CHR$(13) THEN GOTO SAVEEL
 0C8E  02EC          GOSUB CURSORMOVE
 0C94  02EC          GOTO FINDEND
 0C97  02EC  CANCELEL:
 0C9C  02EC          GOSUB PLACECURSOR
 0CA2  02EC          ON FLAGI GOSUB ER1, ER2, ER3, ER4
 0CB3  02EC          FLAGI = 0
 0CBA  02EC          GOTO NEXTEL
 0CBE  02EC  SAVEEL:
 0CC3  02EC          GOSUB PLACECURSOR
 0CC9  02EC          IF FLAGI = 4 THEN CIRCLE (XII+4,YII+4),SQR((XI-XII)^2+(
                     YI-YII)^2),,,,1
 0D32  02EC          GOSUB CORRECT
 0D38  02EC          IF A$="N" THEN GOTO REDRAW
 0D4B  02EC  STOREEL:
 0D50  02EC          SENDATI(ELNUMI,0) = FLAGI
 0D6A  02EC          SENDATI(ELNUMI,1) = XII
 0D85  02EC          SENDATI(ELNUMI,2) = YII
 0DA0  02EC          SENDATI(ELNUMI,3) = XI
 0DBB  02EC          SENDATI(ELNUMI,4) = YI
 0DD6  02EC          SENDATI(ELNUMI,5) = 0
 0DEF  02EC          ELNUMI = ELNUMI + 1
 0DFB  02EC          FLAGI = 0
 0DFF  02EC          GOTO NEXTEL
 0E03  02EC  REM $PAGE
```

```
0E03  02EC  REDRAW:
0E08  02EC          GOSUB ITEMBOXERASE
0E0E  02EC          LINE(1,1)-(318,189),0,BF
0E33  02EC          IF ELNUM% = 0 THEN GOTO NEXTEL
0E42  02EC
0E42  02EC          FOR I=0 TO ELNUM%-1
0E5B  02F0                ON SCNDATX%(I,0) GOSUB RD1, RD2, RD3, RD4
0E81  02F0          NEXT I
0E9C  02F0          GOTO NEXTEL
0EA0  02F0
0EA0  02F0    '******** Sub-routines called by main module ********
0EA0  02F0
0EA0  02F0    SUBMENU:
0EA5  02F0
0EA5  02F0          LOCATE 25,1:PRINT SPACE$(39);
0EC2  02F0          ON MENUNUM GOSUB MENU1, MENU2
0ED1  02F0
0ED1  02F0          FOR I=0 TO 6
0EDB  02F0                READ MENU$(I)
0EF2  02F0                LOCATE 25,(I*6)+2:PRINT MENU$(I);
0F2B  02F0          NEXT I
0F46  02F0
0F46  02F0          READ MAXITEM
0F4D  02F4          ITEM = 0
0F57  02F4
0F57  02F4    NEWITEM:
0F5C  02F4          GOSUB NEWITEMBOX
0F62  02F4
0F62  02F4    NEXTITEM:
0F67  02F4          GOSUB ITEMSEARCH
0F6D  02F4          IF A$ = CHR$(13) THEN RETURN:'  ITEM has correct value
0F84  02F4          IF LEN(A$) < 2 THEN BEEP:GOTO NEXTITEM
0F9A  02F4          IF ASC(MID$(A$,2,1)) = 75 THEN GOTO LEFTAR
0FB6  02F4          IF ASC(MID$(A$,2,1)) = 77 THEN GOTO RIGHTAR
0FD2  02F4          BEEP:GOTO NEXTITEM
0FD9  02F4
0FD9  02F4    LEFTAR:
0FDE  02F4          IF ITEM = 0 THEN GOTO NEXTITEM
0FEE  02F4          GOSUB ITEMBOXERASE
0FF4  02F4          ITEM = ITEM - 1
1003  02F4          GOTO NEWITEM
1007  02F4
1007  02F4    RIGHTAR:
100C  02F4          IF ITEM = MAXITEM THEN GOTO NEXTITEM
101F  02F4          GOSUB ITEMBOXERASE
1025  02F4          ITEM = ITEM + 1
1034  02F4          GOTO NEWITEM
1038  02F4
1038  02F4    MENU1:
103D  02F4          RESTORE MM1
1044  02F4          RETURN
1048  02F4
1048  02F4    MENU2:
104D  02F4          RESTORE MM2
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
1054  02F4          RETURN
1058  02F4
105B  02F4    ITEMSEARCH:
105D  02F4          A$ = INKEY$:IF A$ <> "" THEN RETURN
107A  02F4          GOTO ITEMSEARCH
107D  02F4          RETURN
1081  02F4
1081  02F4    NEWITEMBOX:
1086  02F4          IS = (ITEM*48) + 7
109C  02F8          IE = (ITEM*48) + 8 + LEN(MENUS(ITEM))*8
10D9  02FC          LINE (IS,191)-(IE,199),1,B
1101  02FC          RETURN
1105  02FC
1105  02FC    ITEMBOXERASE:
110A  02FC          LINE (IS,191)-(IE,199),0,B
1131  02FC          RETURN
1135  02FC
1135  02FC    PLACECURSOR:
113A  02FC          PUT (XI+1,YI+1),CURSOR1
1157  02FC          RETURN
115B  02FC
115B  02FC    MOUSEACT:
1160  02FC          GOSUB ANYKEY
1166  02FC          DXI = 0 : DYI = 0
1174  0300          IF A$ = CHR$(0) + CHR$(72) THEN DYI = -1:RETURN
119D  0300          IF A$ = CHR$(0) + CHR$(80) THEN DYI =  1:RETURN
11C6  0300          IF A$ = CHR$(0) + CHR$(77) THEN DXI =  1:RETURN
11EF  0300          IF A$ = CHR$(0) + CHR$(75) THEN DXI = -1:RETURN
1218  0300          IF A$ = "8" THEN DYI = -20:RETURN
1232  0300          IF A$ = "2" THEN DYI =  20:RETURN
124C  0300          IF A$ = "4" THEN DXI = -20:RETURN
1266  0300          IF A$ = "6" THEN DXI =  20:RETURN
1280  0300          IF A$ = CHR$(27) THEN RETURN
1297  0300          IF A$ = CHR$(13) THEN RETURN
12AE  0300          GOTO MOUSEACT
12B2  0300
12B2  0300    CURSORMOVE:
12B7  0300          GOSUB PLACECURSOR
12BD  0300          ON FLAG1 GOSUB ER1, ER2, ER3, ER4
12CE  0300          XI = XI + DXI : YI = YI + DYI
12E6  0300          IF XI < 0 THEN XI = 0
12FB  0300          IF XI > 311 THEN XI = 311
130B  0300          IF YI < 0 THEN YI = 0
131D  0300          IF YI > 182 THEN YI = 182
1330  0300          ON FLAG1 GOSUB DR1, DR2, DR3, DR4
1341  0300          GOSUB DISPCURSOR
1347  0300          RETURN
1348  0300
134B  0300    CORRECT:
1350  0300          LOCATE 25,1:PRINT SPACE$(39);
136D  0300          LOCATE 25,1:PRINT "IS THIS CORRECT? (Y or N) ";
1387  0300    CORLOOP:
138C  0300          GOSUB ANYKEY
1392  0300          IF A$ = "y" OR A$ = "Y" THEN A$ = "Y":GOTO COREXIT
```

```
Offset  Data    Source Line
 13C5   0300            IF A$ = "n" OR A$ = "N" THEN A$ = "N":GOTO COREXIT
 13F8   0300            GOTO CORLOOP
 13FB   0300    COREXIT:
 1400   0300            LOCATE 25,1:PRINT SPACE$(39);
 141D   0300            RETURN
 1421   0300
 1421   0300    DISPCURSOR:
 1426   0300            GOSUB PLACECURSOR
 142C   0300            LOCATE 25,27:PRINT USING "+0.000";IX * GRID;
 1456   0300            PRINT ",";
 1463   0300            PRINT USING "+0.000";YX * GRID;
 1480   0300            RETURN
 1484   0300
 1484   0300
 1484   0300    RD1:
 1489   0300            LINE(SCNDATX(I,1)+4,SCNDATX(I,2)+4)-(SCNDATX(I,3)+4,SCN
                        DATX(I,4)+4)
 1522   0300            RETURN
 1526   0300
 1526   0300    RD2:
 152B   0300            LINE(SCNDATX(I,1)+4,SCNDATX(I,2)+4)-(SCNDATX(I,3)+4,SCN
                        DATX(I,4)+4),,B
 15C4   0300            RETURN
 15C8   0300
 15C8   0300    RD3:
 15CD   0300            LINE(SCNDATX(I,1)+4,SCNDATX(I,2)+4)-(SCNDATX(I,3)+4,SCR
                        DATX(I,4)+4),,BF
 1667   0300            RETURN
 166B   0300
 166B   0300    RD4:
 1670   0300            RADIUSX = SQR((SCNDATX(I,3)-SCNDATX(I,1))^2 + (SCNDATX(
                        I,4)-SCNDATX(I,2))^2)
 16FF   0302            CIRCLE (SCNDATX(I,1)+4,SCNDATX(I,2)+4),RADIUSX,,,,1
 175D   0302            RETURN
 1761   0302
 1761   0302    DR1:
 1766   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4)
 17AF   0302            RETURN
 17B3   0302
 17B3   0302    DR2:
 17B8   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4),,B
 1801   0302            RETURN
 1805   0302
 1805   0302    DR3:
 180A   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4),,BF
 1854   0302            RETURN
 1858   0302
 1858   0302    DR4:
 185D   0302            RETURN
 1861   -0302
 1861   0302    ER1:
 1866   0302            LINE (IIX+4,YIX+4)-(IX+4,YX+4),0
 18AF   0302            RETURN
 18B3   0302
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 18B3   0302   ER2:
 18BB   0302          LINE (XI%+4,YI%+4)-(XI%+4,YI%+4),0,B
 1901   0302          RETURN
 1905   0302
 1905   0302   ER3:
 190A   0302          LINE (XI%+4,YI%+4)-(XI%+4,YI%+4),0,BF
 1954   0302          RETURN
 1958   0302
 1959   0302   ER4:
 195D   0302          RETURN
 1961   0302
 1961   0302   ANYKEY:
 1966   0302          A$ = ""
 1970   0302          WHILE A$ = ""
 197F   0302                A$ = INKEY$
 1989   0302          WEND
 198C   0302          RETURN
 1990   0302
 1990   0302   GETNAME:        'prompt for and get filename
 1995   0302          LOCATE 25,1:PRINT SPACE$(39);
 19B2   0302          LOCATE 25,38:PRINT "<<";:       'boundry chevron
 19CC   0302          LOCATE 25,1:PRINT "Enter Pattern Name    ";
 19E6   0302          LINE INPUT; "",NAME$
 19F4   0302          RETURN
 19FB   0302
 19FB   0302   ' Data fields used by this module
 19FB   0302
 19FB   0302   MN1:
 19FD   0302          DATA "DIR","LOAD","SAVE","DRAW","REPT","EXIT","",5
 19FF   0302
 19FF   0302   MN2:
 1A04   0302          DATA "LINE","RECT","ERECT","CIRCL","REDRW","MAIN","",5
 1A06   0302
 1A06   0302   INSTRUC:
 1A0B   0302          DATA 8,16,"USE ARROWS"
 1A0D   0302          DATA 10,9,"TO SELECT FROM THE MENU"
 1A0F   0302          DATA 14,12,"USE THE ENTER KEY"
 1A11   0302          DATA 16,10,"TO ACTIVATE SELECTION"
 1A13   0302
 1A13   0302   END SUB
 1A1A   0302
 21AF   0302

50426 Bytes Available
43373 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030  0006  REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Burr-Brown PCI-2000
            0 custom driver'
0030  0006  'MODULE   - "PCI" Driver for the PCI-20000 I/O and PULSE cards
0030  0006  '
0030  0006  'AUTHOR   - M. S. Fairchild of Computing Architects Inc.
0030  0006  '                              113 Fairfield Way
0030  0006  '                              Bloomingdale, Il 60108
0030  0006  '                              312/980-6777
0030  0006  '
0030  0006  'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030  0006  '
0030  0006  'REVISION - 1.2 12-16-85 MSF Add digital I/O initalization, and
             output routine
0030  0006  '
0030  0006  '          - 1.1 12-10-85 MSF Move counter module to position 2
0030  0006  '
0030  0006  '          - 1.0 11-22-85 MSF Creation of initial code
0030  0006  '
0030  0006  'SYSTEM   - This code can only be compiled by the BASCOM V2
0030  0006  '            COMPILER, it will not run under the INTERPRETER!!
0030  0006  '
0030  0006  'DESCRIPTION:
0030  0006  '                The PCI module is a group of routines used to a
            ccess
0030  0006  '       the BURR-Brown PCI-20000 board. The supplied software c
            auses
0030  0006  '       the Wordstar2000 software to malfunction and will not p
            rivide
0030  0006  '       explicit on, off functions for the counters.  Custom dr
            ivers
0030  0006  '       will be made to provide all of the desired functions.
0030  0006  '
0030  0006  '
0030  0006  '       Address         Register
0030  0006  '       &HC0000 Carrier I.D. / module present (R)
0030  0006  '       &HC0040 Module interrupt status (R)
0030  0006  '       &HC0080 Digital I/O port 0 (R/W)
0030  0006  '       &HC0081 Digital I/O port 1 (R/W)
0030  0006  '       &HC0082 Buffer direction and enable (R/W)
0030  0006  '       &HC0083 Control for ports 0 and 1 (W)
0030  0006  '       &HC00C0 Digital I/O port 2 (R/W)
0030  0006  '       &HC00C1 Digital I/O port 3 (R/W)
0030  0006  '       &HC00C3 Control for ports 2 and 3 (W)
0030  0006
0030  0006  '           &HC0200         Read module I.D. (1110 1010)
0030  0006  '           &HC0204         Rate generator low-order 16 bits (0)
0030  0006  '           &HC0205         Rate generator high-order 16 bits (1)
0030  0006  '           &HC0206         Counter 3 count register (2)
0030  0006  '           &HC0207         Rate generator/counter 3 control
0030  0006  '           &HC0208         Counter 0 count register (0)
0030  0006  '           &HC0209         Counter 1 count register (1)
0030  0006  '           &HC020A         Counter 2 count register (2)
0030  0006  '           &HC020B         Counter 0 - 2 control
0030  0006  '           &HC020C         Counter gate control (1 enables, 0 disa
```

```
Reagent Jet Printer                                              PAGE  2
Burr-Brown PCI-20000 custom driver                               06-30-86
                                                                 08:38:16
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

                blesi
 0030   0006    '               bit     function
 0030   0006    '               0       Rate generator gate
 0030   0006    '               1       Rate generator gate
 0030   0006    '               2       Counter 0 gate
 0030   0006    '               3       Counter 1 gate
 0030   0006    '               4       Counter 2 gate
 0030   0006    '               5       Counter 3 gate
 0030   0006    '               6       Not used
 0030   0006    '               7       Not used
 0030   0006    '
 0030   0006    '
 0030   0006    'DATA DICTIONARY
 0030   0006    '
 0030   0006    '       COUNT   - Divisor to 2Mhz rate to give desired frequenc
                y or time
 0030   0006    '       COUNTMI         - High order 16 bits of a 32 bit diviso
                r
 0030   0006    '       COUNTLI - Low order 16 bits of a 32 bit divisor
 0030   0006    '       LSBI    - Lower 8 bits of a 16 bit divisor
 0030   0006    '       MSBI    - Upper 8 bits of a 16 bit divisor
 0030   0006
 0030   0006    ' Main line code
 0030   0006    '       The main line code is never executed. It's sole purpose
                 it to
 0030   0006    ' declare shared the variables that will be used in the subrout
                ines
 0030   0006    ' so that they will all be defined and hold their values.
 0030   0006
 0030   0006    MAIN:_
 0030   0006            DIM SHARED COUNT,COUNTMI,COUNTLI,LSBI,MSBI
 0030   0006
 0030   0006    MAINLOOP:_
 0030   0006            GOTO MAINLOOP
 004C   0012
 004C   0012    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
004C  0012  'SUBROUTINE     - PCI.INIT
004C  0012  '
004C  0012  'DESCRIPTION:
004C  0012  '       The PCI.INIT subroutine initalizes the PCI hardware.
004C  0012
004C  0012  SUB PCI.INIT STATIC
0053  0012
0053  0012       DEF SEG = &HC000: 'Point segment to PCI-20000 board
005A  0012
005A  0012       POKE &H020C,&H00: 'Disable all software enabled counter
                 s
0063  0012
0063  0012  ' Configure rate generator to 2 Mhz
0063  0012
0063  0012       POKE &H0207,&H34: 'Set low rate counter to mode 2
006D  0012       POKE &H0207,&H74: 'Set high rate counter to mode 2
0077  0012       POKE &H0204,&H02: 'Load low rate counter with 16 bits o
                 f 2
0081  0012       POKE &H0204,&H00
008A  0012       POKE &H0205,&H02: 'Load high rate counter with 16 bits
                 of 2
0094  0012       POKE &H0205,&H00
009D  0012       POKE &H020C,&H03: 'Enable rate counters
00A7  0012
00A7  0012  ' Configure dot rate counters (default to 5 Khz)
00A7  0012
00A7  0012       POKE &H0208,&H34: 'Set low dot counter (0) to mode 2
00B1  0012       POKE &H0208,&H74: 'Set high dot counter (1) to mode 2
00BB  0012       POKE &H0208,&H04: 'Load low rate counter with 16 bits o
                 f 4
00C5  0012       POKE &H0208,&H00
00CE  0012       POKE &H0209,&H64: 'Load high rate counter with 16 bits
                 of 100
00D8  0012       POKE &H0209,&H00
00E1  0012
00E1  0012  ' Configure dot pulse with one shot (default to 13 usec)
00E1  0012
00E1  0012       POKE &H020B,&H82: 'Set dot pulse with oneshot (2) to mo
                 de 1
00EB  0012       POKE &H020A,&H1A: 'Load oneshot with 16 bits of 26
00F5  0012       POKE &H020A,&H00
00FE  0012
00FE  0012  ' Configure shifted strobe pulse one shot (default to .5 usec)
00FE  0012
00FE  0012       POKE &H0207,&HB2: 'Set shifted strobe onshot (3) to mod
                 e 1
0108  0012       POKE &H0206,&H01: 'Load oneshot with 16 bits of 1
0112  0012       POKE &H0206,&H00
011B  0012
011B  0012  ' Configure port 0 to output and port 1 to input
011B  0012
011B  0012       POKE &H0083,&H82: ' Set up I/O chip
0125  0012       POKE &H0082,&H34: ' Set up direction and enable buffers
012F  0012       POKE &H0080,&H00: ' Dissable print head
```

```
Reagent Jet Printer                                                    PAGE  4
Burr-Brown PCI-20000 custom driver                                     06-30-86
                                                                       08:38:16
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 013B   0012           END SUB
 013F   0012
 013F   0012    REM $PASSIF:12
 013F   0012    'SUBROUTINE     - DOT.ON
 013F   0012    '
 013F   0012    'DESCRIPTION:
 013F   0012    '       The DOT.ON subroutine enables the dot frequency counter
                s.
 013F   0012
 013F   0012    SUB DOT.ON STATIC
 0146   0012
 0146   0012           POKE &H020C,&H0F: 'Enable dot counters and rate generat
                or
 0150   0012
 0150   0012           END SUB
 0157   0012
 0157   0012    REM $PASSIF:12
 0157   0012    'SUBROUTINE     - DOT.OFF
 0157   0012    '
 0157   0012    'DESCRIPTION:
 0157   0012    '       The DOT.OFF subroutine disables the dot counters
 0157   0012
 0157   0012    SUB DOT.OFF STATIC
 015E   0012
 015E   0012           POKE &H020C,&H03: 'Disable dot counters and enable rate
                 generator
 016B   0012
 016B   0012           END SUB
 016F   0012
 016F   0012    REM $PASSIF:49
```

```
Offset  Data    Source Line

016F    0012    'SUBROUTINE     - SET.DOT.RATE
016F    0012    '
016F    0012    'DESCRIPTION:
016F    0012    '       The SET.DOT.RATE subroutine loads the dot rate counters
016F    0012    ' with the desired dot frequency. Allowed range is 10,000 to 1
                Hz.
016F    0012    ' The FREQ parameter is a real number in Hz.
016F    0012
016F    0012    SUB SET.DOT.RATE(FREQ) STATIC
0176    0012
0176    0012    ' Limit freqency to in range
0176    0012
0176    0012            IF FREQ < 1 THEN FREQ = 1
018F    0012            IF FREQ > 10000 THEN FREQ = 10000
01A8    0012
01A8    0012    ' Convert to count and check for 16 bit count or 32 bit count
01A8    0012
01A8    0012            COUNT = 2E6 / FREQ
01B8    0012            IF COUNT < 65536! THEN GOTO DIVIDE16 ELSE GOTO DIVIDE32
01CF    0012
01CF    0012    ' Process count of 32 bits
01CF    0012
01CF    0012    DIVIDE32:_
01D0    0012            COUNTLI = INT((COUNT/32768!) + 1): 'Stage lower count
01F0    0012            COUNTHI = INT(COUNT/COUNTLI): 'Form upper count
020B    0012            GOTO SET.COUNT
020F    0012
020F    0012    ' Process count of 16 bits
020F    0012
020F    0012    DIVIDE16:
0214    0012            COUNTLI = 2
021B    0012            COUNTHI = INT(COUNT/2)
0232    0012            GOTO SET.COUNT
0236    0012
0236    0012    ' Send the derived counts out to the counters
0236    0012
0236    0012    SET.COUNT:_
0237    0012            LSBI = COUNTLI MOD 256: ' Send out low 16 bits
0248    0012            MSBI = INT(COUNTLI / 256)
0263    0012            POKE &H0208,LSBI
0273    0012            POKE &H0208,MSBI
0283    0012
0283    0012            LSBI = COUNTHI MOD 256: 'Send out high 16 bits
0291    0012            MSBI = INT(COUNTHI / 256)
02AC    0012            POKE &H0209,LSBI
02BC    0012            POKE &H0209,MSBI
02CC    0012
02CC    0012            END SUB
02D3    0012
02D3    0012    REM $PAGEIF:27
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

02D3    0012    'SUBROUTINE     - SET.DOT.WIDTH
02D3    0012    '
02D3    0012    'DESCRIPTION:
02D3    0012    '       The SET.DOT.WIDTH subroutine loads the dot width one sh
                ot
02D3    0012    ' with the desired dot pulse width. Allowed range is .5 to 16,0
                00 usec.
02D3    0012    ' The dwidth parameter is a real number in usec.
02D3    0012
02D3    0012    SUB SET.DOT.WIDTH(DWIDTH) STATIC
02DA    0012
02DA    0012    ' Limit width to in range
02DA    0012
02DA    0012            IF DWIDTH < .5 THEN DWIDTH = .5
02F3    0012            IF DWIDTH > 16000 THEN DWIDTH = 16000
030C    0012
030C    0012    ' Convert to count
030C    0012
030C    0012            COUNT = DWIDTH / .5
031A    0012
031A    0012    ' Send the derived count out to the counter
031A    0012
031A    0012            LSBI = INT(COUNT MOD 256): ' Send out 16 bits
0331    0012            MSBI = INT(COUNT / 256)
0348    0012            POKE &H020A,LSBI
035B    0012            POKE &H020A,MSBI
036B    0012
0368    0012            END SUB
036F    0012
036F    0012    REM $PAGEIF:27
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

036F    0012   'SUBROUTINE     - SET.STROBE.DELAY
036F    0012   '
036F    0012   'DESCRIPTION:
036F    0012   '       The SET.STROBE.DELAY subroutine loads the strobe delay
               one shot
036F    0012   ' with the desired strobe delay time. Allowed range is .5 to 16
               ,000 usec.
036F    0012   ' The delay parameter is a real number in usec.
036F    0012
036F    0012   SUB SET.STROBE.DELAY(DELAY) STATIC
0376    0012
0376    0012   ' Limit delay to in range
0376    0012
0376    0012           IF DELAY < .5 THEN DELAY = .5
036F    0012           IF DELAY > 16000 THEN DELAY = 16000
03A8    0012
03A8    0012   ' Convert to count
03A8    0012
03A8    0012           COUNT = DELAY / .5
03B6    0012
03B6    0012   ' Send the derived count out to the counter
03B6    0012
03B6    0012           LSB% = INT(COUNT MOD 256): ' Send out 16 bits
03CD    0012           MSB% = INT(COUNT / 256)
03E4    0012           POKE &H0206,LSB%
03F4    0012           POKE &H0206,MSB%
0404    0012
0404    0012           END SUB
040B    0012
040B    0012   REM $PAGEIF:16
040B    0012   'SUBROUTINE     - DIGITAL.OUT
040B    0012   '
040B    0012   'DESCRIPTION:
040B    0012   '       The DIGITAL.OUT subroutine sends the passed integer to
               the output
040B    0012   '        port 0.
040B    0012
040B    0012   SUB DIGITAL.OUT(BYTE%) STATIC
0412    0012
0412    0012   ' Send the byte to the port
0412    0012
0412    0012           POKE &H0080,BYTE%
0423    0012
0423    0012           END SUB
042A    0012
057F    0012

50426 Bytes Available
48723 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Offset  Data   Source Line
0030    0006  REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Printing' $LINESIZE:132
0030    0006  '[illegible]  - "PATPRINT"
0030    0006  '
0030    0006  'AUTHOR    - M. A. Emerald
0030    0006  '
0030    0006  'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006  '
0030    0006  'REVISION - 2.0 07-02-86 MAE Modified for MicroFab Printhead
0030    0006  '          - 1.1 03-07-86 MAE Added notes and final touches
0030    0006  '            1.0 02-03-86 MAE Creation of initial code
0030    0006  '
0030    0006  'SYSTEM    - This code can only be compiled by the BASCOM
0030    0006  '            COMPILER, it will not run under the INTERPRETER!!
0030    0006  '
0030    0006  'DESCRIPTION:
0030    0006  '       The printing module displays a menu in 3 columns of 4 rows each.  The first
0030    0006  '       column has data from the default reagent profile.  The second column has
0030    0006  '       data from the default pattern file.  The third column has standard printing
0030    0006  '       data.  The four arrow keys allow different menu items to be highlighted and
0030    0006  '       the values can be changed with the + or - keys or by entering the new number
0030    0006  '       followed by Enter.  P will cause the pattern to be printed, S will select the
0030    0006  '       notepad, and E will exit to the main program.  On the notepad, any single line
0030    0006  '       entered here will be sent to the printer.  A null line exits the notepad.
0030    0006  '
0030    0006  'DATA DICTIONARY
0030    0006  '       MENU%          Which menu item is highlighted (0-17)
0030    0006  '       DIFF%          Where to move menu highlight in response to arrow key
0030    0006  '       TYPE%          What key has been pressed during main scan
0030    0006  '       ELEMENT        Number of elements in current pattern
0030    0006  '       SCREEN%(50,5)  Array for storing elements in current pattern
0030    0006  '       REPEAT%        Counter for repeat printing the pattern
0030    0006  '       CT%            Counter for stepping through the pattern array during printing
0030    0006  '       RADIUS%        Radius of circle during printing
0030    0006  '       IT% YT%        Offsets for start row/column position
0030    0006  '       REPI% REPY%    Repeat distances for repeat printing of patterns
0030    0006  '       SX% SY%        Starting X and Y positions for solid rectangles
0030    0006  '       EX% EY%        Ending X and Y positions for solid rectangles
0030    0006  '       I% J%          Counters used for reading pattern files into the array
0030    0006  '       TEMP%          Register for misc. integers
0030    0006  '       NOTELINE%      Pointer to which line is active in the notepad
0030    0006  '       MENU$(17,1)    Array of strings used to display menu items
0030    0006  '       A$             Single keystroke input destination
0030    0006  '       NOTE$          String entered in notepad and sent to printer
0030    0006  '       KEYBUF$        String entered from main scan and assigned to number of string field
0030    0006  '       REAGENT$       Name of default reagent
0030    0006  '       PATTERN$       Name of default pattern
0030    0006  '       FILE$          Name of reagent data file and then pattern data file
0030    0006  '       MENU!(11,4)    Array of values used in displaying menu item numbers
0030    0006  '       TEMP           Register for the temporary storage of real numbers
0030    0006  REM $PAGE
```

```
Reagect Set Printer                                                                    PAGE
Pattern Printing                                                                       09-1
                                                                                       08:4
                                                                  IBM Personal Computer BASIC Compiler V.
 Offset  Data   Source Line

 0030    0064   SUB PATPRINT STATIC
 0047    0064
 0047    0064          DIM SCRDATA(50,5),MENUS(17,1),MENU(17,4)
 0048    0462
 0048    0462          GOSUB INITIALIZE:       'read init. values and set screen
 004E    0462
 004E    0462          WHILE TYPE1 <> 1
 0059    0464
 0059    0464            TYPE1 = 0
 0060    0464            A$ = ""
 006A    0468
 006A    0468            WHILE A$ = ""
 0079    0468              A$ = INKEY$
 0083    0468            WEND
 0086    0468
 0086    0468            IF A$ = "E" OR A$ = "e" THEN TYPE1 = 1:       'exit sub
 0092    0468            IF A$ = "P" OR A$ = "p" THEN TYPE1 = 2:       'print pattern
 00DE    0468            IF A$ = "+" THEN TYPE1 = 3:                   'increment variable
 00F4    0468            IF A$ = "-" THEN TYPE1 = 4:                   'decrement variable
 010A    0468            IF A$ = CHR$(0) + CHR$(72) THEN TYPE1 = 5:    'up arrow key
 012F    0468            IF A$ = CHR$(0) + CHR$(80) THEN TYPE1 = 6:    'down arrow key
 0154    0468            IF A$ = CHR$(0) + CHR$(75) THEN TYPE1 = 7:    'left arrow key.
 0179    0468            IF A$ = CHR$(0) + CHR$(77) THEN TYPE1 = 8:    'right arrow key
 019E    0468            IF A$ > CHR$(47) AND A$ < CHR$(58) THEN TYPE1 = 9:' number 0-9
 01D6    0468            IF A$ = "S" OR A$ = "s" THEN TYPE1 = 10:      'enter scratchpad
 0202    0468
 0202    0468            ON TYPE1 GOSUB T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
 021F    0468
 021F    0468          WEND
 0223    0468          TYPE1 = 0
 022A    0468
 022A    0468          EXIT SUB
 022E    0468
 022E    0468    '************ SUBROUTINES FOR THIS MODULE ************
 022E    0468    T10:    'scratch pad
 0233    0468            SCREEN 0,0,2,2:COLOR 7,0
 0256    0468            LOCATE NOTELINE1,1
 0264    046A    NOTELOOP:
 0269    046A            LINE INPUT NOTE$
 0277    046E            IF NOTE$ = "" THEN SCREEN 0,0,0,0,0:RETURN
 029F    046E            LPRINT NOTE$
 02AC    046E            IF NOTELINE1 < 24 THEN NOTELINE1 = NOTELINE1 + 1
 02C0    046E            GOTO NOTELOOP
 02C3    046E
 02C3    046E
 02C3    046E    T1:
 02C8    046E            RETURN:                 'exit to print menu, no action
 02CC    046E
 02CC    046E    T3:             'process "+" key
 02D1    046E            IF MENU(MENUT,0) >= MENU(MENUT,1) THEN MENU(MENUT,0) = MENU(MENUT,1):RETURN:    'check max value
 033C    0470            MENU(MENUT,0) = MENU(MENUT,0) + MENU(MENUT,2):  'add increment
 0372    0470            COLOR 0,7:GOSUB DISPMENUS:RETURN:                       'show new value
 0388    0470
 0388    0470    T4:             'process "-" key
```

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Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-17
                                                                                       08:49
Offset  Data    Source Line                                  IBM Personal Computer BASIC Compiler V2

                IF MENU(MENUT,0) <= MENU(MENUT,2) THEN MENU(MENUT,0) = MENU(MENUT,2):RETURN:    'check min value
0CB2    0470    MENU(MENUT,0) = MENU(MENUT,0) - MENU(MENUT,3):  'sub increment
0CCE    0470    COLOR 0,7:GOSUB DISPMENU:RETURN:                 'show new value
0CE4    0470
0CE4    0470    T5:             'process up arrow key
0CE9    0470    IF SCROLL AND 4 = 0 THEN RETURN:             'in top row already
0CFC    0470    DIFF% = -1:GOSUB NEWMENU:RETURN:         'move pointer up one
0D0F    0472
0D0F    0472    T6:             'process down arrow key
0D14    0472    IF MENUT AND 4 = 4 THEN RETURN:              'in bottom row already
0D2A    0472    DIFF% = 1:GOSUB NEWMENU:RETURN:              'move pointer down one
0D3B    0472
0D3B    0472    T7:             'process left arrow key
0D40    0472    IF INT(MENUT / 4) = 0 THEN RETURN        'in left column already
0D60    0472    DIFF% = -4:GOSUB NEWMENU:RETURN:         'move pointer one left
0D81    0472
0D81    0472    T8:             'process right arrow key
0D86    0472    IF INT(MENUT / 4) = 2 THEN RETURN        'in right column already
0D9F    0472    DIFF% = 4:GOSUB NEWMENU:RETURN:              'move pointer one right
0DBA    0472
0DBA    0472    T9:             'input keys into KEYBUF$ until (cr) is entered
0DBF    0472    LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0DE1    0472    KEYBUF$ = A$
0DEB    0476    WHILE A$ <> CHR$(13)
0DFE    0476            LOCATE 25,47:PRINT SPACE$(20);
0E18    0476            LOCATE 25,47:PRINT KEYBUF$;
0E35    0476            A$ = ""
0E3F    0476            WHILE A$ = ""
0E4E    0476                    A$ = INKEY$
0E58    0476            WEND
0E5B    0476            IF A$ = CHR$(8) AND LEN(KEYBUF$) > 0 THEN KEYBUF$ = LEFT$(KEYBUF$,LEN(KEYBUF$)-1)
0E7B    0476            IF A$ > CHR$(31) THEN KEYBUF$ = KEYBUF$ + A$
0E1E    0476    WEND
0E22    0476    TEMP = VAL(KEYBUF$)      'temp has value of keys input
0E32    0478
0E32    0478    'round off temp according to step size in menu array
0E32    0478    TEMP = INT(TEMP / (MENU(MENUT,3)) + .5) * MENU(MENUT,3)
0E48    0478
0E48    0478    'test TEMP for maximum and minimum values in menu array
0E4B    0478    IF TEMP > MENU(MENUT,1) THEN TEMP = MENU(MENUT,1)
0E66    0478    IF TEMP < MENU(MENUT,2) THEN TEMP = MENU(MENUT,2)
0E87    0478
0E87    0478    'insert new value into menu array and update screen
0E87    0478    MENU(MENUT,0) = TEMP
0E05    0478    LOCATE 25,30:PRINT SPACE$(40);
0F22    0478    COLOR 0,7:GOSUB DISPMENU
0F34    0478    RETURN
0F38    0478
0F38    0478    T2:     'set Burr-Brown board then print desired pattern
0F3D    0478
0F3D    0478    BEEP:COLOR 15,0:LOCATE 25,1
0F5A    0478    PRINT "Set Potentiometers on Printer....then Press any Key";
0F67    0478    A$ = ""
0F71    0478    WHILE A$ = ""
```

```
5  Ranger Jet Printer                                                                    PAGE
   -Pattern Printing                                                                     09-17
                                                                                         08:49
   Offset  Data    Source Line                                  IBM Personal Computer BASIC Compiler V2

    0780   047A              AS = INKEY$
10  078A   047A          NEXT
    0780   047A          LOCATE 25,1:PRINT SPACE$(79);
    07AA   047A
    07AA   047A          'enter drop parameters into burr-brown board
    07AA   047A          TEMP = MENU(0,0):CALL SET.DOT.RATE(TEMP)
    07B3   047A          TEMP = 5:CALL SET.DOT.WIDTH(TEMP)
15  07ED   047A          TEMP = MENU(2,0):CALL SET.STROBE.DELAY(TEMP)
    0819   047A          CALL DOT.ON
    0825   047A
    0825   047A          TEMP1 = 4
    0822   047C          CALL DIGITAL.OUT(TEMP1)
    083C   047C          TEMP1 = 0:                    'pulse RESET line
20  0843   047C          CALL DIGITAL.OUT(TEMP1)
    0253   047C          TEMP1 = 4
    085A   047C          CALL DIGITAL.OUT(TEMP1)
    086A   047C
    086A   047C          J1 = CINT(MENU(1,0) * 255 / 150): 'set pulse amplitude by pulsing HIGHER signal J1 number of times
    0893   047E          FOR I1 = 1 TO J1
25  08A0   0480                TEMP1 = 6:              'set HIGHER true
    08A7   0480                CALL DIGITAL.OUT(TEMP1)
    08B7   0480                TEMP1 = 4:              'set HIGHER false
    08BE   0480                CALL DIGITAL.OUT(TEMP1)
    08CE   0480          NEXT I1
    08E0   0482
30  08E0   0482          'establish COM1: and initialize plotter
    08E0   0482          OPEN "COM1:2400,N,8,2,CS 65535" AS #1
    08F2   0482          PRINT #1,";:IN;SC5,E7Y1,A";
    0902   0482
    0902   0482          'move nozzle offset and establish new origin
    0902   0482          PRINT #1,"AO";
35  0912   0482
    0912   0482          'calculate row/column location, move there, and set new origin
    0912   0482          X1 = (MENU(12,0)-1) * (MENU(14,0) / 0.005)
    0954   0484          Y1 = (MENU(13,0)-1) * (MENU(15,0) / 0.005)
    0996   0486          PRINT #1,X1;Y1;"D";
40  09B4   0486
    09B4   0486          'print the pattern using repeat count
    09B4   0486          REPY1 = MENU(8,0) / 0.005
    09D7   0488          REPX1 = MENU(9,0) / 0.005
    09FA   048A
    09FA   048A          FOR REPEAT1 = 0 TO MENU(7,0)
45  0A1C   048C
    0A1C   048C                'print the pattern
    0A1C   048C                FOR CT1 = 0 TO ELMUM1 - 1
    0A2A   0490                      ON SCHDAT1(CT1,0) GOSUB PLINE, PREET, PSREET, PCIRCL
    0A4C   0492                NEXT CT1
    0A5E   0492
    0A5E   0492                PRINT #1,"A,0,0,";:     'return to origin
50  0A8E   0492                PRINT #1,REPX1;REPY1;"D";: 'move to next pattern
    0A8C   0492          NEXT REPEAT1
    0AA1   0494
    0AA1   0494          PRINT #1,"H";:  'return plotter to original HOME
    0AB1   0494
55
```

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5   Request Jet Printer                                                                    PAGE
    Pattern Printing                                                                       09-17
                                                                                           08:49
    Offset  Data    Source Line                                   IBM Personal Computer BASIC Compiler V2

    0A51    0494            CLOSE #1:       'disable comm:
10  0A58    0494
    0A58    0494            RETURN
    0A5C    0494
    0A5C    0494    PLINE:
    0A61    0494            PRINT #1,SCRDATX(CTX,2);SCRDATX(CTX,1);"D";
    0B03    0494            PRINT #1,SCRDATX(CTX,4);SCRDATX(CTX,3);"U";
15  0B45    0494            RETURN
    0B49    0494
    0B49    0494    PRECT:
    0B4E    0494            PRINT #1,SCRDATX(CTX,2);SCRDATX(CTX,1);"D";
    0B90    0494            PRINT #1,SCRDATX(CTX,4);SCRDATX(CTX,1);
    0BCC    0494            PRINT #1,SCRDATX(CTX,4);SCRDATX(CTX,3);
20  0C08    0494            PRINT #1,SCRDATX(CTX,2);SCRDATX(CTX,3);
    0C44    0494            PRINT #1,SCRDATX(CTX,2);SCRDATX(CTX,1);"U";
    0C86    0494            RETURN
    0C8A    0494
    0C8A    0494    PCIRCL:
    0C3F    0494            RADIUSX = SQR((SCRDATX(CTX,3)-SCRDATX(CTX,1))^2 + (SCRDATX(CTX,4)-SCRDATX(CTX,2))^2)
25  0D1A    0496            PRINT #1,"CC ";SCRDATX(CTX,2);SCRDATX(CTX,1);RADIUSX;
    0D63    0496            RETURN
    0D67    0496
    0D67    0496    PSRECT:
    0D6C    0496            SIX = SCRDATX(CTX,4):EIX = SCRDATX(CTX,2)
30  0DA0    049A            SYX = SCRDATX(CTX,3):EYX = SCRDATX(CTX,1)
    0DD4    049E            IF EIX <= SIX THEN SIX = SCRDATX(CTX,2):EIX = SCRDATX(CTX,4)
    0E15    049E            IF EYX <= SYX THEN SYX = SCRDATX(CTX,1):EYX = SCRDATX(CTX,3)
    0E56    049E
    0E56    049E            PRINT #1,SIX;SYX;"D";
    0E74    049E
35  0E74    049E            IF EIX - SIX >= EYX - SYX THEN GOSUB STEPY ELSE GOSUB STEPX
    0E9D    049E
    0E9D    049E            PRINT #1,"U";
    0EAD    049E            RETURN
    0EB1    049E
    0EB1    049E    STEPY:
40  0EB6    049E            PRINT #1,EIX;SYX;
    0ECE    049E            SYX = SYX + 1
    0ED7    049E            IF SYX > EYX THEN RETURN
    0EEB    049E            PRINT #1,EIX;SYX;SIX;SYX;
    0F0E    049E            SYX = SYX + 1
    0F17    049E            IF SYX > EYX THEN RETURN
45  0F28    049E            PRINT #1,SIX;SYX;
    0F40    049E            GOTO STEPY
    0F44    049E
    0F44    049E    STEPX:
    0F49    049E            PRINT #1,SIX;EYX;
    0F61    049E            SIX = SIX + 1
50  0F6A    049E            IF SIX > EIX THEN RETURN
    0F78    049E            PRINT #1,SIX;EYX;SIX;SYX;
    0FA1    049E            SIX = SIX + 1
    0FAA    049E            IF SIX > EIX THEN RETURN
    0FB8    049E            PRINT #1,SIX;SYX;
    0FD3    049E            GOTO STEPX
55
```

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Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-17
                                                                                       08:49
                                                                  IBM Personal Computer BASIC Compiler V2
   Offset  Data    Source Line

   0FD7    049E
   0FD7    049E    KEYMENU: 'write old item in yellow, point to and highlight new item
   0FDC    049E             COLOR 14,0:GOSUB DISPMENU
   0FEE    049E             MENUI = MENUI + DIFFI
   0FFA    049E             IF MENUI = 10 THEN MENUI = 9
   100C    049E             IF MENUI = 11 THEN MENUI = 9
   101E    049E             IF MENUI > 15 THEN MENUI = 15
   1030    049E             COLOR 0,7:GOSUB DISPMENU:RETURN
   1046    049E
   1046    049E    INITIALIZE:
   1048    049E             'change to screen 0 and display messages
   1048    049E             SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,17:PRINT "Loading selected Reagent and Pattern Data Files";
   108F    049E             LOCATE 12,33:PRINT "Please Wait..."
   10A9    049E
   10A9    049E             'initialize notepad on screen 2
   10A9    049E             SCREEN 0,0,2,1:CLS:COLOR 15
   10CE    049E             PRINT"Digital Notepad - - -All information typed here is sent to the printer"
   10DB    049E             NOTELINE1 = 3
   10E2    049E
   10E2    049E             'initialize menu arrays
   10E2    049E             RESTORE ARRDATA
   10E9    049E             FOR II=0 TO 17
   10EF    049E                    READ MENUS(II,0),MENUS(II,1)
   111F    049E                    READ MENU(II,1),MENU(II,2),MENU(II,3),MENU(II,4)
   1180    049E             NEXT II
   1193    049E
   1193    049E             'get default reagent file and read values
   1193    049E
   1193    049E             OPEN "READEF.RJP" FOR INPUT AS #1
   11A4    049E             INPUT #1,FILE$
   11B6    04A2             INPUT #1,READNAME$
   11C8    04A6             CLOSE #1
   11CF    04A6
   11CF    04A6             OPEN FILE$ FOR INPUT AS #1:     'get reagent data
   11E0    04A6             INPUT #1,MENU(0,0):             'frequency
   1200    04A6             INPUT #1,MENU(1,0):             'amplitude
   1223    04A6             INPUT #1,MENU(2,0):             'strobe delay
   1246    04A6             INPUT #1,MENU(3,0):             'pulse width
   1269    04A6             INPUT #1,MENU(4,0):             'rise time
   128C    04A6             INPUT #1,MENU(5,0):             'fall time
   12B1    04A6             CLOSE #1
   12B8    04A6
   12B8    04A6             'get default pattern file and read values
   12B8    04A6
   12B8    04A6             OPEN "PATDEF.RJP" FOR INPUT AS #1
   12C9    04A6             INPUT #1,FILE$
   12D8    04A6             INPUT #1,PATNAME$
   12ED    04AA             CLOSE #1
   12F4    04AA
   12F4    04AA             OPEN FILE$ FOR INPUT AS #1:     'get pattern data
   1305    04AA             INPUT #1,ELEMENTS
   1317    04AA             INPUT #1,MENU(6,0):             'grid
   132A    04AA             INPUT #1,MENU(7,0):             'repeat count
   133D    04AA             INPUT #1,MENU(8,0):             'x offset
```

```
6  Reagent Jet Printer                                                                                    PAGE
   Pattern Printing                                                                                       04-17
                                                                                                          08:09
   Offset  Data    Source Line                                                  IBM Personal Computer BASIC Compiler V2

    1380   04AA          INPUT #1,MENU(9,0);            'y offset
10  13A3   04AA          FOR II = 0 TO E_NUMS-1
    13B1   04AC                FOR JI = 0 TO 5
    13B7   04AC                      INPUT #1,SCRDATS(II,JI)
    13D8   04AC                NEXT JI
    13E8   04AC          NEXT II
    13F0   04AC          CLOSE #1
15  1404   04AC
    1404   04AC          'set remaining parameters in menu array
    1404   04AC
    1404-  04AC          MENU(12,0) = 1:                'row 1
    1420   04AC          MENU(13,0) = 1:                'column 1
    143C   04AC          MENU(14,0)-= 0:                'row spacing
20  1458   04AC          MENU(15,0) = 0:                'column spacing
    1474   04AC
    1474   04AC          'change active displayed screen to screen 0 to draw and display parameters
    1474   04AC
    1474   04AC          SCREEN 0,0,0,1:CLS
    1491   04AC
25  1491   04AC          COLOR 13:LOCATE 1,32:PRINT "REAGENT PRINTING";
    1482   04AC          COLOR 9
    1489   04AC          FOR I=2 TO 79
                              LOCATE 3,I:PRINT CHR$(196);:LOCATE 5,I:PRINT CHR$(205);:LOCATE 18,I:PRINT CHR$(196);
    14C3   04AC
    1523   0480          NEXT I
    153E   0480          FOR I=4 TO 17
30  1548   0480                LOCATE I,1:PRINT CHR$(179);:LOCATE I,28:PRINT CHR$(186);:LOCATE I,54:PRINT CHR$(186);:LOCATE I,5
RINT CHR$(179);
    15C8   0480          NEXT I
    15E6   0480          RESTORE TABLE
    15ED   0480          FOR I=1 TO 12
35  15F7   0480                READ R1,C1,N$:LOCATE R1,C1:PRINT CHR$(NC);
    162A   0486          NEXT I
    1645   0486
    1645   0486          'display 16 menu choices in yellow
    1645   0486
    1645   0486          COLOR 14,0
40  1651   0486          FOR MENUI = 0 TO 15
    1657   0486                GOSUB DISPMENU
    1658   0486          NEXT MENUI
    166D   0486
    166D   0486          'set for first menu entry and highlight it
    166D   0486          MENUI = 0:COLOR 0,7
45  1680   0486          GOSUB DISPMENU
    1686   0486
    1686   0486          'print three headings and instructions
    1686   0486          COLOR 10,0
    1692   0486          LOCATE 4,14.5-LEN(REANAME$)/2:PRINT REANAME$;
    16C1   0486          LOCATE 4,41-LEN(PATNAME$)/2:PRINT PATNAME$;
50  16F0   0486          LOCATE 4,60:PRINT "PRINT LOCATION";
    170A   0486
    170A   0486          COLOR 7:LOCATE 19,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
    1754   0486          PRINT CHR$(32);CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
    1793   0486          LOCATE 20,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
    17E7   0486          COLOR 7:PRINT" to scroll current value up or down";
55
```

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Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-17-
                                                                                       08:49:
                                                                  IBM Personal Computer BASIC Compiler V2.

  Offset  Data   Source Line

 17FD   0486          LOCATE 21,5:PRINT "Use ";:COLOR 15:PRINT "P";:COLOR 7:PRINT " to print pattern or ";
 183F   0486          COLOR 15:PRINT "E";:COLOR 7:PRINT " to exit to print menu";
 1867   0486          PRINT " or ";:COLOR 15:PRINT "S";:COLOR 7:PRINT " to use notepad";
 189C   0486
 189C   0486          'set screen to view menu just created and exit
 189C   0486
 189C   0486          SCREEN 0,0,0,0
 18B1   0486          RETURN
 18B5   0486
 18B5   0486    DISPMENU:
 18BA   0486          IF MENUI = 10 OR MENUI = 11 THEN RETURN
 1EEE   0486          LOCATE (MENUI MOD 6)*2+7,(INT(MENUI/6)*28+2)-2*INT(MENUI/12)
 1938   0486          PRINT MENUS(MENUI,0)
 1956   0486          LOCATE (MENUI MOD 6)*2+7,MENU(MENUI,4)
 1969   0486          PRINT USING MENUS(MENUI,1);MENU(MENUI,0);
 1988   0486          RETURN
 192F   0486    REM SPACE
```

```
'Request: Jet Printer                                                                    PAGE
Pattern Printing                                                                         09-17
                                                                                         08:49
Offset  Data   Source Line                                   IBM Personal Computer BASIC Compiler V2

 19BF  0486   '************ DATA USED BY THIS MODULE ************
 19BF  0486
 19BF  0486   &&&DATA:
 19C4  0486           DATA "Dot Frequency          Hz",".##,###",10000,1,1,16
 19C6  0486           DATA "Amplitude               V ","###",150.0,1,19
 19CB  0486           DATA "Strobe Delay           uS",".##,###.#",15999.5,.5..5,16
 19CA  0486           DATA "Pulse Width              ","###",999.0,1,19
 19CC  0486           DATA "Rise Time                ","###",999,0,1,19
 19CE  0486           DATA "Fall Time                ","###",999,0,1,19
 19D0  0486           DATA "Grid Size              in","#.###",.005,.005,.005,45
 19D2  0486           DATA "Repeat Count             ","##",99,0,1,47
 19D4  0486           DATA "X Axis Offset          in","#.###",2,0,.005,45
 19D6  0486           DATA "Y Axis Offset          in","#.###",2,0,.005,45
 19D8  0486           DATA "","",0,0,0,0
 19DA  0486           DATA "","",0,0,0,0
 19DC  0486           DATA "Row to Print         ","##",99,1,1,74
 19DE  0486           DATA "Column to Print      ","##",99,1,1,74
 19E0  0486           DATA "Row Spacing            in","#.###",3,0,.005,72
 19E2  0486           DATA "Column Spacing         in","#.###",3,0,.005,72
 19E4  0486           DATA "","",0,0,0,0
 19E6  0486           DATA "","",0,0,0,0
 19E8  0486
 19E8  0486   TABLE:
 19ED  0486           DATA 3,1,218
 19EF  0486           DATA 3,28,210
 19F1  0486           DATA 3,54,210
 19F3  0486           DATA 3,80,191
 19F5  0486           DATA 5,1,178
 19F7  0486           DATA 5,28,206
 19F9  0486           DATA 5,54,206
 19FB  0486           DATA 5,80,181
 19FD  0486           DATA 18,1,192
 19FF  0486           DATA 18,28,208
 1A01  0486           DATA 18,54,208
 1A03  0486           DATA 15,80,217
 1A05  0486
 1A05  0486   END SUB
 1A0C  0486
 1A0C  0486
 2049  0486

50426 Bytes Available
44716 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030 0006  '$INCLUDE: 'REAFILE' $SUBTITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Filing'
0030 0006  '$INCLUDE  - "REAFILE" File Handling for reagents
0030 0006  '
0030 0006  'AUTHOR   - M. A. Enevold
0030 0006  '
0030 0006  'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030 0006  '
0030 0006  'REVISION - 1.1 03-07-86 MAE Added notes and description
0030 0006  '           1.0 02-14-86 MAE Creation of initial code
0030 0006  '
0030 0006  'SYSTEM   - This code can only be compiled by the BASCOM
0030 0006  '           COMPILER, it will not run under the INTERPRETER!!
0030 0006  '
0030 0006  'DESCRIPTION:
0030 0006  '       This module allow file handling for reagents.  When inv
           oked, it displays
0030 0006  '       the current contents of the reagent directory in 4 colu
           mns of 20 entries
0030 0006  '       each.  The reagent which is currently selected for prin
           ting is marked by
0030 0006  '       an asterisk to the left of the reagent name.  After the
            directory is listed
0030 0006  '       the user is presented with 5 menu choices.  The left an
           d right arrows are
0030 0006  '       used to highlight menu items and the enter key is used
           to invoke action.
0030 0006  '       The menu choices and their actions are:
0030 0006  '
0030 0006  '              DELETE - Remove a reagent file from the directo
           ry
0030 0006  '              COPY -   Copy a reagent file to a new reagent n
           ame, saving the old reagent
0030 0006  '              RENAME - Change the name of the reagent without
            changing the reagent itself
0030 0006  '              SELECT - Selct a reagent for printing
0030 0006  '              EXIT -   Return to the main menu
0030 0006  '
0030 0006  'DATA DICTIONARY
0030 0006  '       TYPE%      Which type of valid key was pushed
0030 0006  '       MENU%      Which menu item is being pointer to (0-4)
0030 0006  '       DIFF%      Distance to move MENU% at left or right arro
           w
0030 0006  '       FLAG%      Error type 0-4
0030 0006  '       POINTER%   Position of REANAME$ in directory list
0030 0006  '       REANUM%           Number of reagent names in directory
            list
0030 0006  '       TEMP%      Storage for integers during reagent copy
0030 0006  '       A$         Misc. input string
0030 0006  '       FUNCT$     Printed at bottom of screen during prompt fo
           r reagent name
0030 0006  '       REANAME$   Reagent name currently being worked on
0030 0006  '       SELNAME$   Reagent name currently selected for printing
0030 0006  '       FILE$      Filename of reagent data file
0030 0006  '       SFILE$     Filename for source reagent data file used d
```

```
Reagent Jet Printer                                                    PAGE  2
Reagent Filing                                                         07-09-86
                                                                       15:04:35
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

                during copy
 0030   0006   '       DFILE$      Filename for destination reagent data file u
sed during copy
 0030   0006   '       NEWNAME$    New reagent name for COPY and RENAME
 0030   0006   '       TEMP$       Reagent names are held here as the directory
 is being re-written
 0030   0006   '       NEWFILE$    Destination filename used while copying reag
ent data files
 0030   0006   '       MESSAGE$    A message printed at the bottom of the scree
n
 0030   0006   '       MENU$(4,1) Array of strings containing the short and lo
ng menu names
 0030   0006   '       ERRMSG$     Message printed when any error occurs
 0030   0006   '       ERR$        Appended to ERRMSG$ to indicate nature of er
ror
 0030   0006   REM $PAGE


Reagent Jet Printer                                                    PAGE  3
Reagent Filing                                                         07-09-86
                                                                       15:04:35
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006   SUB REAGENT.FILE STATIC
 0047   0006
 0047   0006           GOSUB INITIALIZE
 004D   0006           TYPE1 = 0
 0054   0008
 0054   0008           WHILE TYPE1 <> 3
 005F   0008                   A$ = ""
 0069   000C                   WHILE A$ = ""
 0078   000C                           A$ = INKEY$
 0082   000C                   WEND
 0085   000C                   IF A$ = CHR$(0) + CHR$(75) THEN TYPE1 = 1:
'left arrow
 00AA   000C                   IF A$ = CHR$(0) + CHR$(77) THEN TYPE1 = 2:
'right arrow
 00CF   000C                   IF A$ = CHR$(13) THEN TYPE1 = 3:
'(cr) to execute selection
 00E9   000C
 00E9   000C                   ON TYPE1 GOSUB T1, T2, T3
 00F8   000C           WEND
 00FC   000C
 00FC   000C           EXIT SUB
 0100   000C
 0100   000C   REM $PAGE
```

Reagent Jet Printer
Reagent Filing

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0100  000C  '******** SUB-ROUTINES FOR THIS MODULE ********
0100  000C
0100  000C  T1:             'left arrow
0105  000C          TYPE1 = 0
010C  000C          IF MENU% = 0 THEN RETURN
011B  000E          DIFF1 = -1
0122  0010          GOSUB NEW.MENU
0128  0010          RETURN
012E  0010
012E  0010  T2:             'right arrow
0131  0010          TYPE1 = 0
0138  0010          IF MENU% = 4 THEN RETURN
0147  0010          DIFF1 = 1
014E  0010          GOSUB NEW.MENU
0154  0010          RETURN
015B  0010
015B  0010  T3:             '<cr>  (execute selected menu item)
015D  0010          LOCATE 25,1:PRINT SPACE$(79);
017A  0010          ON MENU% + 1 GOSUB T3A, T3B, T3C, T3D, T3E
018F  0010          GOSUB MENU.ON
0195  0010          RETURN
0199  0010
0199  0010  REM $PAGE
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00
 0199   0010   T3A:            'delete reagent
 019E   0010          TYPE% = 0
 01A5   0010          FUNCT$ = "Delete"
 01AF   0014          GOSUB GET.SOURCE
 01B5   0014          IF LEN(REANAME$) = 0 THEN RETURN
 01C7   0018          IF REANAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
                      RETURN
 01E7   001E          GOSUB SEARCH
 01ED   001E          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 0209   0020
 0209   0020          MESSAGE$ = "Deleting " + REANAME$ + "     Please Wait..
                      ."
 0220   0024          GOSUB MESSAGE.ON
 0226   0024
 0226   0024                  'rewrite directory deleting REANAME$ as indicat
                      ed by POINTER%
 0226   0024          KILL "READIR.OLD"
 022D   0024          NAME "READIR.RJP" AS "READIR.OLD"
 0237   0024          OPEN "READIR.OLD" FOR INPUT AS #1
 0248   0024          OPEN "READIR.RJP" FOR OUTPUT AS #2
 025A   0024
 025A   0024          INPUT #1, REANUM%
 026C   0026          REANUM% = REANUM% - 1
 0275   0026          WRITE #2,REANUM%
 0286   0026
 0286   0026          IF REANUM% = 0 THEN GOTO DIR.DONE
 0295   0026          FOR I% = 1 TO REANUM% + 1
 02A4   0028                  INPUT #1,REANAME$
 02B6   002B                  IF I% <> POINTER% THEN PRINT #2,REANAME$
 02D3   002A          NEXT I%
 02E5   002A
 02E5   002A    DIR.DONE:
 02EA   002A          CLOSE #1:CLOSE #2
 02FB   002A
 02FB   002A                  'remove data file
 02FB   002A          FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                      "REA.RJP"
 031C   002E          KILL FILE$
 0323   002E
 0323   002E                  'rename remaining data files to maintain linked
                       list to directory
 0323   002E          WHILE (REANUM% + 1) > POINTER%
 0333   002E                  SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
                      ER%+1))-1) + "REA.RJP"
 0359   0032                  DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
                      %))-1) + "REA.RJP"
 037D   0036                  NAME SFILE$ AS DFILE$
 0387   0036                  POINTER% = POINTER% + 1
 0390   0036          WEND
 0393   0036
 0393   0036          GOSUB MESSAGE.OFF
 0399   0036          REANAME$ = SELNAME$
 03A3   0036          GOSUB T3DA
 03A9   0036          GOSUB DISP.DIR
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
03AF  0036          RETURN
03B3  0036
03B3  0036    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
 5
 03B3   0036    T3B:    'copy reagent
 03B8   0036            TYPE% = 0
 03BF   0036            IF REANUM% = 80 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
 03DB   0036            FUNCT$ = "Copy"
10 03E5 0036            GOSUB GET.SOURCE
 03EB   0036            IF LEN(REANAME$) = 0 THEN RETURN
 03FD   0036            GOSUB SEARCH
 0403   0036            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 041F   0036
15 041F 0036            GOSUB GET.NEW.NAME
 0425   0036            IF LEN(NEWNAME$) = 0 THEN RETURN
 0437   003A            IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                    ETURN
 0457   003A
20 0457 003A            MESSAGE$ = "Copying " + REANAME$ + " to " + NEWNAME$ +
                     "    Please wait.."
 047C   003A            GOSUB MESSAGE.ON
 0482   003A
 0482   003A                    'add new name at end of directory
25 0482 003A            KILL "READIR.OLD"
 0489   003A            NAME "READIR.RJP" AS "READIR.OLD"
 0493   003A            OPEN "READIR.OLD" FOR INPUT AS #1
 04A4   003A            OPEN "READIR.RJP" FOR OUTPUT AS #2
 04B6   003A
30 04B6 003A            INPUT #1, REANUM%
 04C8   003A            REANUM% = REANUM% + 1
 04D1   003A            WRITE #2,REANUM%
 04E2   003A
 04E2   003A            FOR I% = 1 TO REANUM% - 1
35 04F1 003C                    INPUT #1,TEMP$
 0503   0040                    PRINT #2,TEMP$
 0513   0040            NEXT I%
 0525   0040            PRINT #2,NEWNAME$
 0535   0040
40 0535 0040            CLOSE #1:CLOSE #2
 0543   0040
 0543   0040                    'create copy of data file
 0543   0040            FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                    "REA.RJP"
45 0567 0040            NEWFILE$ = RIGHT$(STR$(REANUM%),LEN(STR$(REANUM%))-1) +
                     "REA.RJP"
 05BB   0044
 05BB   0044            OPEN FILE$ FOR INPUT AS #1
 05CC   0044            OPEN NEWFILE$ FOR OUTPUT AS #2
50 05AE 0044
 05AE   0044            INPUT #1,TEMP
 05C0   0048            WRITE #2,TEMP:  'frequency
 05D0   0048            INPUT #1,TEMP
 05E2   0048            WRITE #2,TEMP:  'pulse width
55 05F2 0048            INPUT #1,TEMP
 0604   0048            WRITE #2,TEMP:  'strobe delay
 0614   0048            INPUT #1,TEMP
 0626   0048            WRITE #2,TEMP:  'nozzle
 0636   0048
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0636    0048            INPUT #1,TEMP$
0648    0048            PRINT #2,TEMP$:       'concentration
065B    0048            INPUT #1,TEMP$
066A    0048            PRINT #2,TEMP$:       'density
067A    0048            INPUT #1,TEMP$
068C    0048            PRINT #2,TEMP$:       'viscosity
069C    0048
069C    0048            CLOSE #1:CLOSE #2
06AA    0048
06AA    0048            GOSUB MESSAGE.OFF
06B0    0048            GOSUB DISP.DIR
06B6    0048            RETURN
06BA    0048
06BA    0048    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
06BA  0046  TOC:    'rename reagent
06BF  0048          TYPE% = 0
06C6  0048          FUNCT$ = "Rename"
06D0  0048          GOSUB GET.SOURCE
06D6  0048          IF LEN(REANAME$) = 0 THEN RETURN
06E8  0048          GOSUB SEARCH
06EE  0048          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
070A  0048
070A  0048          GOSUB GET.NEW.NAME
0710  0048          IF LEN(NEWNAME$) = 0 THEN RETURN
0722  0048          IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                  ETURN
0742  0048          IF NEWNAME$ = REANAME$ THEN RETURN
0755  0048          MESSAGE$ = "Renaming " + REANAME$ + " to " + NEWNAME$ +
                    "  Please wait.."
077A  0048          GOSUB MESSAGE.ON
0780  0048
0780  0048                'renaming reagent name in directory
0780  0048          KILL "READIR.OLD"
0787  0048          NAME "READIR.RJP" AS "READIR.OLD"
0791  0048          OPEN "READIR.OLD" FOR INPUT AS #1
07A2  0048          OPEN "READIR.RJP" FOR OUTPUT AS #2
07B4  0048
07B4  0048          INPUT #1, REANUM%
07C6  0048          WRITE #2,REANUM%
07D7  0048
07D7  0048          FOR I% = 1 TO REANUM%
07E4  004A                INPUT #1,TEMP$
07F6  004A                IF I% <> POINTER% THEN PRINT #2,TEMP$
0813  004A                IF I% = POINTER% THEN PRINT #2,NEWNAME$
0830  004A          NEXT I%
0842  004A
0842  004A          CLOSE #1:CLOSE #2
0850  004A
0850  004A          GOSUB MESSAGE.OFF
0856  004A          IF REANAME$ = SELNAME$ THEN REANAME$ = NEWNAME$:GOSUB T
                  ODA
0875  004A          GOSUB DISP.DIR
087B  004A          RETURN
087F  004A
087F  004A    REM $PAGE
```

```
Offset  Data    Source Line        IBM Personal Computer BASIC Compiler V2.00

 067F   004A    TJD:    'select reagent for printing
 0683   004A            TYPE1 = 0
 0688   004A            FUNCTS = "Select"
 068F   004A            GOSUB GET.SOURCE
 0693   004A            IF LEN(REANAME$) = 0 THEN RETURN
 08AB   004A            IF REANAME$ = SELNAME$ THEN RETURN
 08C9   004A            GOSUB TJDA
 08C6   004A            GOSUB DISP.DIR
 08CC   004A            RETURN
 08D0   004A
 08D0   004A    TJDA:
 08D5   004A            GOSUB SEARCH
 08DB   004A            IF POINTER1 = 0 THEN FLAG1 = 1:GOSUB SHOW.ERROR:RETURN
 08F7   004A
 08F7   004A            MESSAGE$ = "Selecting " + REANAME$ + "     Please Wait.
                    .."
 090E   004A            GOSUB MESSAGE.ON
 0914   004A
 0914   004A                    'change entrys in reagent default file READEF.R
                    JP
 0914   004A            OPEN "READEF.RJP" FOR OUTPUT AS #1
 0926   004A            FILE$ = RIGHT$(STR$(POINTER1),LEN(STR$(POINTER1))-1) +
                    "REA.RJP"
 094A   004A
 094A   004A            PRINT #1,FILE$
 095A   004A            PRINT #1,REANAME$
 096A   004A
 096A   004A            CLOSE #1
 0971   004A            GOSUB MESSAGE.OFF
 0977   004A            RETURN
 097B   004A
 097B   004A    TJE:    'exit reagent filing
 0980   004A            RETURN
 0984   004A
 0984   004A    REM $PAGE
```

```
Reagent Set Printer                                                    PAGE  11
Reagent Filing                                                         07-09-86
                                                                       15:04:35
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
 5
 0984   004A    SEARCH:
 0989   004A            POINTER% = 0
 0990   004A            OPEN "READIR.RJP" FOR INPUT AS #1
 09A1   004A            INPUT #1,REANUM%:'      get number of reagents in direc
10                      tory
 09B3   004A            IF REANUM% = 0 THEN CLOSE #1:RETURN
 09C9   004A            TEMP$ = ""
 09D3   004A            WHILE (POINTER% < REANUM%) AND (REANAME$ <> TEMP$)
 09FB   004A                    LINE INPUT #1,TEMP$
15 0A06   004A                    POINTER% = POINTER% + 1
 0A11   004A            WEND
 0A14   004A            IF REANAME$ <> TEMP$ THEN POINTER% = 0
 0A2A   004A            CLOSE #1
 0A31   004A            RETURN
20 0A35   004A
 0A35   004A    GET.SOURCE:
 0A3A   004A            LOCATE 25,1:COLOR 15,0:PRINT "Enter Reagent Name to "FU
                        NCTS"  ";
 0A6C   004A            LINE INPUT;"",REANAME$
25 0A7A   004A            LOCATE 25,1:PRINT SPACE$(79);
 0A97   004A            RETURN
 0A9B   004A
 0A9B   004A    GET.NEW.NAME:
 0AA0   004A            LOCATE 25,1:COLOR 15,0:PRINT "Enter New Reagent Name ";
30 0AC6   004A            LINE INPUT;"",NEWNAME$
 0AD4   004A            LOCATE 25,1:PRINT SPACE$(79);
 0AF1   004A            RETURN
 0AF5   004A
 0AF5   004A    DISP.DIR:       'display reagent directory in 4 columns of 20 r
35                      ows
 0AFA   004A                    'read selected reagent into SELNAME$
 0AFA   004A            OPEN "READEF.RJP" FOR INPUT AS #1
 0B0B   004A            INPUT #1,SELNAME$:      'read and discard data file nam
                        e
40 0B1D   004A            INPUT #1,SELNAME$:      'read and save reagent name
 0B2F   004A            CLOSE #1
 0B36   004A
 0B36   004A            OPEN "READIR.RJP" FOR INPUT AS #1
 0B47   004A            INPUT #1,REANUM%:'      read number of reagents
45 0B59   004A            MESSAGE$ = "Reading Reagent Directory  Please Wait"
 0B63   004A            GOSUB MESSAGE.ON
 0B69   004A            FLAG% = 0
 0B70   004A            TEMP% = REANUM% - 1:IF REANUM% < 80 THEN TEMP% = REANUM
                        %
50 0B8B   004C            FOR I% = 0 TO TEMP%
 0B97   004E                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
 0BCA   004E                    PRINT SPACE$(18);
 0BDA   004E            NEXT I%
 0BEC   004E
 0BEC   004E            FOR I% = 0 TO REANUM% - 1
55 0BFA   0050                    INPUT #1,REANAME$
 0C0C   0050                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
 0C3F   0050                    PRINT REANAME$;
 0C4C   0050                    IF REANAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
                1,(INT(I%/20)*20)+1:PRINT "*";
0C9E  0050              NEXT I%
0CB0  0050              CLOSE #1
0CB7  0050              GOSUB MESSAGE.OFF
0CBD  0050              RETURN
0CC3  0050
0CC3  0050      INITIALIZE:
0CC6  0050              DIM MENU$(4,1)
0CC7  0078              MENU$(0,0) = "Delete"
0CDF  0078              MENU$(0,1) = "Remove a reagent file from the directory"
0CFA  0078              MENU$(1,0) = "Copy"
0D15  0078              MENU$(1,1) = "Copy a reagent file to a new reagent name
0D2E  0078              MENU$(2,0) = "Rename"
0D4B  0078              MENU$(2,1) = "Rename a reagent file in the directory"
0D69  0078              MENU$(3,0) = "Select"
0D84  0078              MENU$(3,1) = "Select a reagent file to be printed"
0DA0  0078              MENU$(4,0) = "Exit"
0DBB  0078              MENU$(4,1) = "Return to the main menu"
0DD7  0078
0DD7  0078              COLOR 9,0:CLS
0DEA  0078              LOCATE 21,1
0DF7  0078              FOR I% = 1 TO 80
0DFE  0078                      PRINT "D";
0E0B  0078              NEXT I%
0E1B  0078
0E1B  0078              FOR MENU% = 0 TO 4
0E21  0078                      GOSUB MENU.OFF
0E27  0078              NEXT MENU%
0E37  0078
0E37  0078              GOSUB DISP.DIR
0E3B  0078              IF FLAG% > 0 THEN GOSUB SHOW.ERROR
0E4E  0078              MENU% = 4
0E55  0078              GOSUB MENU.ON
0E5B  0078
0E5B  0078              RETURN
0E5F  0078
0E5F  0078      NEW.MENU:
0E64  0078              GOSUB MENU.OFF
0E6A  0078              MENU% = MENU% + DIFF%
0E76  0078              GOSUB MENU.ON
0E7C  0078              RETURN
0E80  0078
0E80  0078      MENU.ON:
0E85  0078              LOCATE 22,(MENU%*10)+18
0E9C  0078              COLOR 0,7
0EAB  0078              PRINT MENU$(MENU%,0);
0EC6  0078              LOCATE 25,40-LEN(MENU$(MENU%,1))/2
0EFA  0078              COLOR 7,0
0F06  0078              PRINT MENU$(MENU%,1);
0F25  0078              RETURN
0F29  0078
0F29  0078      MENU.OFF:
0F2E  0078              LOCATE 22,(MENU%*10)+18
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
 0F45   0078            COLOR 14,0
 0F51   0078            PRINT MENUS(MENUX,0);
 0F6F   0078            LOCATE 25,40-LEN(MENUS(MENUX,1))/2
 0FA3   0078            PRINT SPACES(LEN(MENUS(MENUX,1)));
 0FCB   0078            RETURN
 0FCC   0078
 0FCC   0078    SHOW.ERROR:
 0FD1   0078            ON FLAGZ GOSUB ER1, ER2, ER3, ER4
 0FE2   0078            ERRMSG$ = ERR$ + "     Strike any key.."
 0FF2   0080            LOCATE 24,40-LEN(ERRMSG$)/2
 1014   0080            COLOR 13,0
 1020   0080            PRINT ERRMSG$;
 102D   0080            A$ = ""
 1037   0080            WHILE A$ = ""
 1046   0080                    A$ = INKEY$
 1050   0080            WEND
 1053   0080            GOSUB MESSAGE.OFF
 1059   0080            RETURN
 105D   0080
 105D   0080    ER1:
 1062   0080            ERR$ = REANAME$ + " Not Found in the Directory"
 1072   0080            RETURN
 1076   0080
 1076   0080    ER2:
 107B   0080            ERR$ = "Reagent Name is too Long (15 characters max.)"
 1085   0080            RETURN
 1089   0080
 1089   0080    ER3:
 109E   0080            ERR$ = "Directory is Full (80 reagents max.)"
 1098   0080            RETURN
 109C   0080
 109C   0080    ER4:
 10A1   0080            ERR$ = "Cannot Modify SELECTd reagent Name"
 10AB   0080            RETURN
 10AF   0080
 10AF   0080    MESSAGE.ON:
 10B4   0080            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                GE$;
 10EF   0080            RETURN
 10F3   0080
 10F3   0080
 10F3   0080    MESSAGE.OFF:
 10FB   0080            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
 1121   0080            RETURN
 1125   0080
 1125   0080    END SUB
 112C   0080
 16C9   0080

50426 Bytes Available
45718 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0030 0006 REM $TITLE:'Reagent Jet Printer  $SUBTITLE:'Pattern Filing'
0030 0006 'MODULE   - "PATFILE" File Handling for patterns
0030 0006 '
0030 0006 'AUTHOR   - M. A. Enevold
0030 0006 '
0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030 0006 '
0030 0006 'REVISION - 1.0 02-12-86 MAE Creation of initial code
0030 0006 '
0030 0006 'SYSTEM   - This code can only be compiled by the BASCOM
0030 0006 '           COMPILER, it will not run under the INTERPRETER!!
0030 0006 '
0030 0006 'DESCRIPTION:
0030 0006 '       This module allow file handling for patterns.  When inv
                  oked, it displays
0030 0006 '       the current contents of the pattern directory in 4 colu
                  mns of 20 entries
0030 0006 '       each.  The pattern which is currently selected for prin
                  ting is marked by
0030 0006 '       an asterisk to the left of the pattern name.  After the
                   directory is listed
0030 0006 '       the user is presented with 5 menu choices.  The left an
                  d right arrows are
0030 0006 '       used to highlight menu items and the enter key is used
                  to invoke action.
0030 0006 '       The menu choices and their actions are:
0030 0006 '
0030 0006 '             DELETE - Remove a pattern file from the directo
                  ry
0030 0006 '             COPY -   Copy a pattern file to a new pattern n
                  ame, saving the old pattern
0030 0006 '             RENAME - Change the name of the pattern without
                   changing the pattern itself
0030 0006 '             SELECT - Selct a pattern for printing
0030 0006 '             EXIT -   Return to the main menu
0030 0006 '
0030 0006 'DATA DICTIONARY
0030 0006 '       TYPE%      Which type of valid key was pushed
0030 0006 '       MENU%      Which menu item is being pointer to (0-4)
0030 0006 '       DIFF%      Distance to move MENU% at left or right arro
                  w
0030 0006 '       FLAG%      Error type 0-4
0030 0006 '       POINTER%   Position of PATNAME$ in directory list
0030 0006 '       PATNUM%          Number of pattern names in directory
                   list
0030 0006 '       ELNUM%     Number of elements in a pattern file
0030 0006 '       TEMP%      Storage for integers during pattern copy
0030 0006 '       I%         Counter used during pattern copy
0030 0006 '       J%         Counter used during pattern copy
0030 0006 '       A$         Misc. input string
0030 0006 '       FUNCT$     Printed at bottom of screen during prompt fo
                  r pattern name
0030 0006 '       PATNAME$   Pattern name currently being worked on
0030 0006 '       SELNAME$   Pattern name currently selected for printing
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006   '       FILE$       Filename of pattern data file
 0030   0006   '       SFILE$      Filename for source pattern data file used d
uring copy
 0030   0006   '       DFILE$      Filename for destination pattern data file u
sed during copy
 0030   0006   '       NEWNAME$    New pattern name for COPY and RENAME
 0030   0006   '       TEMP$       Pattern names are held here as the directory
 is being re-written
 0030   0006   '       NEWFILE$    Destination filename used while copying patt
ern data files
 0030   0006   '       MESSAGE$    A message printed at the bottom of the scree
n
 0030   0006   '       MENU$(4,1) Array of strings containing the short and lo
ng menu names
 0030   0006   '       ERRMSG$     Message printed when any error occurs
 0030   0006   '       ERR$        Appended to ERRMSG$ to indicate nature of er
ror
 0030   0006   '       TEMP        Storage of real variables while copying patt
ern data files
 0030   0006   REM $PAGE
```



```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006   SUB PATTERN.FILE STATIC
 0047   0006
 0047   0006           GOSUB INITIALIZE
 004D   0006           TYPE1 = 0
 0054   0008
 0054   0008           WHILE TYPE1 <> 3
 005F   0008                   A$ = ""
 0069   000C                   WHILE A$ = ""
 007B   000C                         A$ = INKEY$
 0082   000C                   WEND
 0085   000C                   IF A$ = CHR$(0) + CHR$(75) THEN TYPE1 = 1:
'left arrow
 00AA   000C                   IF A$ = CHR$(0) + CHR$(77) THEN TYPE1 = 2:
'right arrow
 00CF   000C                   IF A$ = CHR$(13) THEN TYPE1 = 3:
'(cr) to execute selection
 00E9   000C
 00E9   000C                   ON TYPE1 GOSUB T1, T2, T3
 00FB   000C           WEND
 00FC   000C
 00FC   000C           EXIT SUB
 0100   000C
 0100   000C    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0100  000C  '******** SUB-ROUTINES FOR THIS MODULE ********
0100  000C
0100  000C  T1:             'left arrow
0105  000C          TYPE1 = 0
010C  000C          IF MENU1 = 0 THEN RETURN
011B  000E          DIFF1 = -1
0122  0010          GOSUB NEW.MENU
012B  0010          RETURN
012C  0010
012C  0010  T2:             'right arrow
0131  0010          TYPE1 = 0
0138  0010          IF MENU1 = 4 THEN RETURN
0147  0010          DIFF1 = 1
014E  0010          GOSUB NEW.MENU
0154  0010          RETURN
015B  0010
015B  0010  T3:             '<cr>  (execute selected menu item)
015D  0010          LOCATE 25,1:PRINT SPACE$(79);
017A  0010          ON MENU1 + 1 GOSUB T3A, T3B, T3C, T3D, T3E
018F  0010          GOSUB MENU.ON
0195  0010          RETURN
0199  0010
0199  0010  REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
                                                                                5
0199    0010    TSA:            delete pattern
019E    0010            TYPE1 = 0
01A5    0010            FLAG1$ = "Delete"
01AF    0014            GOSUB GET.SOURCE
01B5    0014            IF LEN(PATNAME$) = 0 THEN RETURN                        10
01C7    0018            IF PATNAME$ = SELNAME$ THEN FLAG1 = 4:GOSUB SHOW.ERROR:
                        RETURN
01E7    001E            GOSUB SEARCH
01ED    001E            IF POINTER1 = 0 THEN FLAG1 = 1:GOSUB SHOW.ERROR:RETURN  15
0209    0020
0209    0020            MESSAGE$ = "Deleting " + PATNAME$ + "     Please Wait..
                        "
0220    0024            GOSUB MESSAGE.ON
0226    0024
0226    0024                    'rewrite directory deleting PATNAME$ as indicat  20
                        ed by POINTER1
0226    0024            KILL "PATDIR.OLD"
022D    0024            NAME "PATDIR.RJP" AS "PATDIR.OLD"
0237    0024            OPEN "PATDIR.OLD" FOR INPUT AS #1
0248    0024            OPEN "PATDIR.RJP" FOR OUTPUT AS #2                      25
025A    0024
025A    0024            INPUT #1, PATNUM1
026C    0026            PATNUM1 = PATNUM1 - 1
0275    0026            WRITE #2,PATNUM1
0286    0026                                                                    30
0286    0026            IF PATNUM1 = 0 THEN GOTO DIR.DONE
0295    0026            FOR I1 = 1 TO PATNUM1 + 1
02A4    0028                    INPUT #1,PATNAME$
02B6    0028                    IF I1 <> POINTER1 THEN PRINT #2,PATNAME$
02D3    002A            NEXT I1                                                 35
02E5    002A
02E5    002A    DIR.DONE:
02EA    002A            CLOSE #1:CLOSE #2
02FB    002A
02FB    002A                    'remove data file                               40
02FB    002A            FILE$ = RIGHT$(STR$(POINTER1),LEN(STR$(POINTER1))-1) +
                        ".PAT.RJP"
031C    002E            KILL FILE$
0323    002E
0323    002E                    'rename remaining data files to maintain linked  45
                         list with directory
0373    002E            WHILE (PATNUM1 + 1) > POINTER1
0333    002E                    SFILE$ = RIGHT$(STR$(POINTER1+1),LEN(STR$(POINT
                        ER1+1))-1) + ".PAT.RJP"
0359    0032                    DFILE$ = RIGHT$(STR$(POINTER1),LEN(STR$(POINTER  50
                        1))-1) + ".PAT.RJP"
0370    0036                    NAME SFILE$ AS DFILE$
0387    0036                    POINTER1 = POINTER1 + 1
0390    0036            WEND
0393    0036                                                                    55
0393    0036            GOSUB MESSAGE.OFF
0399    0036            PATNAME$ = SELNAME$
03A3    0036            GOSUB TSDA
03A9    0036            GOSUB DISP.DIR
```

```
Offset  Data    Source Line
 03AF   0036            RETURN
 03B3   0036
 03B3   0036    REM $PAGE
```

```
Offset  Data   Source Line        IBM Personal Computer BASIC Compiler V2.00
 5
 03B3   0036   TOP:    'copy pattern
 03B8   0036           TYPE% = 0
 03BF   0036           IF PATNUM% = 80 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
 03DB   0036           FUNCT$ = "Copy"
10 03E5 0036           GOSUB GET.SOURCE
 03E8   0036           IF LEN(PATNAME$) = 0 THEN RETURN
 03F5   0036           GOSUB SEARCH
 0403   0036           IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 041F   0036
15 041F 0036           GOSUB GET.NEW.NAME
 0425   0036           IF LEN(NEWNAME$) = 0 THEN RETURN
 0437   003A           IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                      ETURN
 0457   003A
20 0457 003A           MESSAGE$ = "Copying " + PATNAME$ + " to " + NEWNAME$ +
                       "   Please wait.."
 047C   003A           GOSUB MESSAGE.ON
 0482   003A
 0482   003A                   'add NEWNAME$ at end of directory
25 0482 003A           KILL "PATDIR.OLD"
 0489   003A           NAME "PATDIR.RJP" AS "PATDIR.OLD"
 0493   003A           OPEN "PATDIR.OLD" FOR INPUT AS #1
 04A4   003A           OPEN "PATDIR.RJP" FOR OUTPUT AS #2
 04B6   003A
30 04B6 003A           INPUT #1, PATNUM%
 04C8   003A           PATNUM% = PATNUM% + 1
 04D1   003A           WRITE #2,PATNUM%
 04E2   003A
 04E2   003A           FOR I% = 1 TO PATNUM% - 1
35 04F1 003C                   INPUT #1,TEMP$
 0503   0040                   PRINT #2,TEMP$
 0513   0040           NEXT I%
 0525   0040           PRINT #2,NEWNAME$
 0535   0040
40 0535 0040           CLOSE #1:CLOSE #2
 0543   0040
 0543   0040                   'create copy of pattern data file
 0543   0040           FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                       "PAT.RJP"
45 0567 0040           NEWFILE$ = RIGHT$(STR$(PATNUM%),LEN(STR$(PATNUM%))-1) +
                        "PAT.RJP"
 05BB   0044
 05BB   0044           OPEN FILE$ FOR INPUT AS #1
 059C   0044           OPEN NEWFILE$ FOR OUTPUT AS #2
50 05AE 0044
 05AE   0044           INPUT #1,ELNUM%
 05C0   0046           WRITE #2,ELNUM%
 05D1   0046
 05D1   0046           FOR I% = 1 TO 4
55 05DB 0046                   INPUT #1,TEMP
 05EA   004A                   WRITE #2,TEMP
 05FA   004A           NEXT I%
 060A   004A
 060A   004A           FOR I% = 1 TO ELNUM%
```

```
Reagent Jet Printer                                                PAGE  9
Pattern Filing                                                     07-09-86
                                                                   15:11:46
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0842   0052            RETURN
 0846   0052
 0846   0052    REM $PAGE
```

```
Reagent Jet Printer                                                PAGE 10
Pattern Filing                                                     07-09-86
                                                                   15:11:46
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0846   0052    T3D:            'select pattern for printing
 084B   0052            TYPE1 = 0
 0852   0052            FUNCT$ = "Select"
 085C   0052            GOSUB GET.SOURCE
 0862   0052            IF LEN(PATNAME$) = 0 THEN RETURN
 0874   0052            IF PATNAME$ = SELNAME$ THEN RETURN
 0887   0052            GOSUB T3DA
 088D   0052            GOSUB DISP.DIR
 0893   0052            RETURN
 0897   0052
 0897   0052    T3DA:
 089C   0052            GOSUB SEARCH
 08A2   0052            IF POINTER1 = 0 THEN FLAG1 = 1:GOSUB SHOW.ERROR:RETURN
 08BE   0052
 08BE   0052            MESSAGE$ = "Selecting " + PATNAME$ + "     Please Wait.
                        .."
 08D5   0052            GOSUB MESSAGE.ON
 08D8   0052
 08D8   0052                    'change entrys in pattern default file PATDEF.R
                        JP
 08DB   0052            OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 08ED   0052            FILE$ = RIGHT$(STR$(POINTER1),LEN(STR$(POINTER1))-1) +
                        "PAT.RJP"
 0911   0052
 0911   0052            PRINT #1,FILE$
 0921   0052            PRINT #1,PATNAME$
 0931   0052
 0931   0052            CLOSE #1
 0938   0052            GOSUB MESSAGE.OFF
 093E   0052            RETURN
 0942   0052
 0942   0052    T3E:    'exit pattern filing
 0947   0052            RETURN
 094B   0052
 094B   0052    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0948    0052    SEARCH:
0956    0052            POINTER% = 0
0957    0052            OPEN "PATDIR.RJP" FOR INPUT AS #1
0968    0052            INPUT #1,PATNUM%:'      get number of patterns in direc
                tory
097A    0052            IF PATNUM% = 0 THEN CLOSE #1:RETURN
0990    0052            TEMP$ = ""
099A    0052            WHILE (POINTER% < PATNUM%) AND (PATNAME$ <> TEMP$)
09C2    0052                    LINE INPUT #1,TEMP$
09CF    0052                    POINTER% = POINTER% + 1
09D8    0052            WEND
09DB    0052            IF PATNAME$ <> TEMP$ THEN POINTER% = 0
09F1    0052            CLOSE #1
09FB    0052            RETURN
09FC    0052
09FC    0052    GET.SOURCE:
0A01    0052            LOCATE 25,1:COLOR 15,0:PRINT "Enter Pattern Name to "FU
                NCT$"  ";
0A33    0052            LINE INPUT:"",PATNAME$
0A41    0052            LOCATE 25,1:FRINT SPACE$(79);
0A5E    0052            RETURN
0A62    0052
0A62    0052    GET.NEW.NAME:
0A67    0052            LOCATE 25,1:COLOR 15,0:PRINT "Enter New Pattern Name ";
0A8D    0052            LINE INPUT:"",NEWNAME$
0A9B    0052            LOCATE 25,1:PRINT SPACE$(79);
0AB8    0052            RETURN
0ABC    0052
0ABC    0052    DISP.DIR:       'display directory in 4 columns, 20 rows
                                'read default pattern name into SELNAME$
0AC1    0052            OPEN "PATDEF.RJP" FOR INPUT AS #1
0AC1    0052            INPUT #1,SELNAME$:      'discard data file name
0AD2    0052            INPUT #1,SELNAME$
0AE4    0052            CLOSE #1
0AF6    0052
0AFD    0052            OPEN "PATDIR.RJP" FOR INPUT AS #1
0AFD    0052            INPUT #1,PATNUM%:'      read number of patterns
0B0E    0052
0B20    0052            MESSAGE$ = "Reading Pattern Directory  Please Wait"
0B20    0052            GOSUB MESSAGE.ON
0B2A    0052            FLAG% = 0
0B30    0052            TEMP% = PATNUM% - 1:IF PATNUM% < 80 THEN TEMP% = PATNUM
                %
0B37    0052            FOR I% = 0 TO TEMP%
0B52    0052                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
0B5E    0054                    PRINT SPACE$(18);
0B91    0054            NEXT I%
0BA1    0054
0BB3    0054            FOR I% = 0 TO PATNUM% - 1
0BB3    0054                    INPUT #1,PATNAME$
0BC1    0056                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
0BD3    0056                    PRINT PATNAME$;
0C06    0056                    IF PATNAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
0C13    0056            1,(INT(I%/20)*20)+1:PRINT "*";
```

```
0C62  0056          NEXT I%
0C77  0056          CLOSE #1
0C7E  0056          GOSUB MESSAGE.OFF
0C84  0056          RETURN
0C86  0056
0C88  0056    INITIALIZE:
0C8D  0056          DIM MENU$(4,1)
0C8E  007E          MENU$(0,0) = "Delete"
0CA6  007E          MENU$(0,1) = "Remove a pattern file from the directory"
0CC1  007E          MENU$(1,0) = "Copy"
0CDC  007E          MENU$(1,1) = "Copy a pattern file to a new pattern name
                    "
0CF5  007E          MENU$(2,0) = "Rename"
0D12  007E          MENU$(2,1) = "Rename a pattern file in the directory"
0D30  007E          MENU$(3,0) = "Select" _
0D4B  007E          MENU$(3,1) = "Select a pattern file to be printed"
0D67  007E          MENU$(4,0) = "Exit"
0D82  007E          MENU$(4,1) = "Return to the main menu"
0D9E  007E
0D9E  007E          COLOR 9,0:CLS
0DB1  007E          LOCATE 21,1
0DBE  007E          FOR I% = 1 TO 80
0DC5  007E                PRINT "D";
0DD2  007E          NEXT I%
0DE2  007E
0DE2  007E          FOR MENU% = 0 TO 4
0DEB  007E                GOSUB MENU.OFF
0DEE  007E          NEXT MENU%
0DFE  007E
0DFE  007E          GOSUB DISP.DIR
0E04  007E          IF FLAG% > 0 THEN GOSUB SHOW.ERROR
0E15  007E          MENU% = 4
0E1C  007E          GOSUB MENU.ON
0E22  007E
0E22  007E          RETURN
0E26  007E
0E26  007E    NEW.MENU:
0E2B  007E          GOSUB MENU.OFF
0E31  007E          MENU% = MENU% + DIFF%
0E3D  007E          GOSUB MENU.ON
0E43  007E          RETURN
0E47  007E
0E47  007E    MENU.ON:
0E4C  007E          LOCATE 22,(MENU%*10)+18
0E63  007E          COLOR 0,7
0E6F  007E          PRINT MENU$(MENU%,0);
0E8D  007E          LOCATE 25,40-LEN(MENU$(MENU%,1))/2
0EC1  007E          COLOR 7,0
0ECD  007E          PRINT MENU$(MENU%,1);
0EEC  007E          RETURN
0EF0  007E
0EF0  007E    MENU.OFF:
0EF5  007E          LOCATE 22,(MENU%*10)+18
0F0C  007E          COLOR 14,0
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
5
 0F18   007E            PRINT MENU$(MENUZ,0);
 0F36   007E            LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
 0F6A   007E            PRINT SPACE$(LEN(MENU$(MENUZ,1)));
 0F8F   007E            RETURN
10
 0F93   007E
 0F93   007E    SHOW.ERROR:
 0F9B   007E            ON FLAGZ GOSUB ER1, ER2, ER3, ER4
 0FA9   007E            ERRMSG$ = ERR$ + "     Strike any key.."
 0FB9   0086            LOCATE 24,40-LEN(ERRMSG$)/2
15
 0FDB   0086            COLOR 13,0
 0FE7   0086            PRINT ERRMSG$;
 0FF4   0086            A$ = ""
 0FFE   0086            WHILE A$ = ""
 100D   0086                    A$ = INKEY$
20
 1017   0086            WEND
 101A   0086            GOSUB MESSAGE.OFF
 1020   0086            RETURN
 1024   0086
 1024   0086    ER1:
25
 1029   0086            ERR$ = PATNAME$ + " Not Found in the Directory"
 1039   0086            RETURN
 103D   0086
 103D   0086    ER2:
 1042   0086            ERR$ = "Pattern Name is too Long (15 characters max.)"
30
 104C   0086            RETURN
 1050   0086
 1050   0086    ER3:
 1055   0086            ERR$ = "Directory is Full (80 patterns max.)"
 105F   0086            RETURN
35
 1063   0086
 1063   0086    ER4:
 1068   0086            ERR$ = "Cannot Modify SELECTd pattern Name"
 1072   0086            RETURN
 1076   0086
40
 1076   0086    MESSAGE.ON:
 107B   0086            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                GE$;
 10B6   0086            RETURN
 10BA   0086
45
 10BA   0086
 10BA   0086    MESSAGE.OFF:
 10BF   0086            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
 10EB   0086            RETURN
 10EC   0086
50
 10EC   0086    END SUB
 10F3   0086
 1688   0086

 50426 Bytes Available
55
 45670 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00
                                                                              5
 0030   0006   REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Main Line Code'
 0030   0006
 0030   0006   'MODULE   - "MAIN"
 0030   0006
                                                                              10
 0030   0006   'AUTHOR   - M. A. Enevold
 0030   0006
 0030   0006   'COPYRIGHT (C) 1986 ABBOTT LABORATORIES
 0030   0006
 0030   0006   'REVISION - 1.1 02-19-86 MAE Add notes and revise TYPE1 resetin
                                                                              15
                g
 0030   0006   '          - 1.0 02-14-86 MAE Creation of initial code
 0030   0006
 0030   0006   'SYSTEM   - This code can only be compiled by the BASCOM
 0030   0006   '            COMPILER, it will not run under the INTERPRETER!!
                                                                              20
 0030   0006
 0030   0006   'DESCRIPTION
 0030   0006   '       This is the main controlling module for the Reagent Jet
                 Printer.
 0030   0006   '       It displays a menu in table form that allows 6 function
                                                                              25
                s to be
 0030   0006   '       selected.  PATTERN DEFINITION allows the user to define
                 patterns
 0030   0006   '       to be printed.  PATTERN FILING lets the user delete, co
                py, rename
                                                                              30
 0030   0006   '       and select patterns for printing.  REAGENT CALIBRATION
                permits setting
 0030   0006   '       of operation parameters for different reagents.  REAGEN
                T FILING is
 0030   0006   '       the same as pattern filing.  PRINTING PRINT prints the
                                                                              35
                selected
 0030   0006   '       pattern with the selected reagent.  SYSTEM EXIT TO DOS
                ends the session.
 0030   0006   '       Using up and down arrow keys let the user move through
                 the menu and
                                                                              40
 0030   0006   '       the Enter <cr> key activates the selection.
 0030   0006
 0030   0006   'DATA DICTIONARY
 0030   0006   '       MENU%          This value represents the current menu
                 item (0-5)
                                                                              45
 0030   0006   '       MENU$(5,1)     String array for displaying menu items.
                  6 rows by 2 columns
 0030   0006   '                      Each row corresponds to a menu item (0-
                5)
 0030   0006   '                      First column is short menu name in high
                                                                              50
                lighted area
 0030   0006   '                      Second column is long description displ
                ayed at menu bottom
 0030   0006   '       MROW%(5)       This array stores to row in which the s
                hort menu name will be displayed
                                                                              55
 0030   0006   '       DIFF%          This value is used it change MENU% in r
                esponse to arrow keys
 0030   0006   '       TYPE%          This value is set based on which valid
                 key is pressed
 0030   0006   '                      0 = No valid key.  1 = Up Arrow.  2 = D
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

                own Arrow.  3 = (cr).
 0030   0006    '       TEMP%        Used to store MENU% while screen is ref
                reshed
 0030   0006    '       A$           Used to store single input keystrokes
 0030   0006    '       C$           Used to store special graphics characte
                rs used in drawing the menu table
 0030   0006    '       I%           Counter used to refresh display
 0030   0006    '       R%           Row in which special graphics character
                 is displayed
 0030   0006    '       C%           Column in which special graphics charac
                ter is displayed
 0030   0006    REM $PAGE
```



```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006
 0030   0006    'Main-line code for RJP Reagent Jet Printer
 0030   0006
 0030   0006    MAIN.LINE.CODE:
 0030   0006
 0043   0006            GOSUB INITIALIZE
 0043   0006
 0046   0006            WHILE TYPE% <> 3
 0056   0008
 0056   0008                    TYPE% = 0
 005D   0008                    A$ = ""
 0067   000C                    WHILE A$ = ""
 0076   000C                            A$ = INKEY$
 0080   000C                    WEND
 0083   000C
 0083   000C                    IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 1:'
                up arrow
 00A8   000C                    IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 2:'
                down arrow
 00CD   000C                    IF A$ = CHR$(13) THEN TYPE% = 3:'
                (cr) execute command
 00E7   000C
 00E7   000C                    ON TYPE% GOSUB T1, T2, T3
 00F6   000C
 00F6   000C            WEND
 00FA   000C
 00FA   000C            CLS
 0101   000C            COLOR 7,0,0
 0112   000C            SYSTEM
 0116   000C
 0116   000C    REM $PAGE
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 0116   000C   '******** SUB-ROUTINES FOR MAIN PROGRAM
 0116   000C   T1:     'up arrow
 011B   000C           IF MENU1 = 0 THEN RETURN
 012A   000E           DIFF1 = -1
 0131   0010           GOSUB NEW.MENU
 0137   0010           RETURN
 013B   0010
 013B   0010   T2:     'down arrow
 0140   0010           IF MENU1 = 5 THEN RETURN
 014F   0010           DIFF1 = 1
 0156   0010           GOSUB NEW.MENU
 015C   0010           RETURN
 0160   0010
 0160   0010   T3:
 0165   0010           ON MENU1 + 1 GOSUB T31, T32, T33, T34, T35, T36
 017C   0010           IF MENU1 < 5 THEN TYPE2 = 0:'  reset TYPE2 so progra
                      won't end
 013E   0010           SCREEN 0,0,3,3
 01A5   0010           RETURN
 01A9   0010
 01A9   0010   T31:    'pattern definition
 01AE   0010           CALL PATENTRY:          'in module PATENT
 01BA   0010           GOSUB REFRESH
 01C0   0010           RETURN
 01C4   0010
 01C4   0010   T32:    'pattern filing
 01C9   0010           SCREEN 0,0,0,0:CLS
 01E5   0010           CALL PATTERN.FILE:      'in module PATFILE
 01F1   0010           RETURN
 01F5   0010
 01F5   0010   T33:    'reagent calibration
 01FA   0010           CALL REAGENT.CALIBRATE: 'in module REACAL
 0206   0010           RETURN
 020A   0010
 020A   0010   T34:    'reagent filing menu
 020F   0010           SCREEN 0,0,0,0:CLS
 022B   0010           CALL REAGENT.FILE:      'in module REAFILE
 0237   0010           RETURN
 023B   0010
 023B   0010   T35:    'print pattern
 0240   0010           CALL PATPRINT:          'in module PATPRINT
 024C   0010           RETURN
 0250   0010
 0250   0010   T36:    'exit system, don't reset TYPE2
 0255   0010           RETURN
 0259   0010
 0259   0010   REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0259   0010   NEW.MENU:
 025E   0010          GOSUB MENU.OFF
 0264   0010          MENU% = MENU% + DIFF%
 0270   0010          GOSUB MENU.ON
 0276   0010          RETURN
 027A   0010
 027A   0010   INITIALIZE:
 027F   0010          CALL PCI.INIT
 0285   0010
 028B   0010   '       define and initialize arrays
 028B   0010          DIM MROW%(5)
 028C   001C          MROW%(0) = 4
 029E   001C          MROW%(1) = 6
 02B1   001C          MROW%(2) = 10
 02C4   001C          MROW%(3) = 12
 02D7   001C          MROW%(4) = 16
 02EA   001C          MROW%(5) = 20
 02FD   001C
 02FD   001C          DIM MENU$(5,1)
 02FE   004C          RESTORE MENU.STRING.DATA
 0305   004C          FOR I% = 0 TO 5
 030B   004C                READ MENU$(I%,0),MENU$(I%,1)
 033B   004E          NEXT I%
 034B   004E
 034B   004E   '       set initial values into variables
 034B   004E          TYPE% = 0
 0352   004E          MENU% = 0
 0359   004E
 0359   004E   REFRESH: 'redraw screen and highlight current menu selection
 035E   004E
 035E   004E          SCREEN 0,0,0,0:CLS:COLOR 7,0,0
 038B   004E          LOCATE 10,32:PRINT "Loading Menu....."
 03A5   004E          SCREEN 0,0,3,0:CLS
 03C2   004E
 03C2   004E
 03C2   004E          COLOR 13,0
 03CE   004E          LOCATE 1,3:
 03DB   004E          PRINT "REAGENT JET PRINTER";
 03E8   004E          COLOR 10,0
 03F4   004E          LOCATE 5,26
 0401   004E          PRINT "PATTERN"
 040E   004E          LOCATE 11,26
 041B   004E          PRINT "REAGENT"
 0428   004E          LOCATE 16,26
 0435   004E          PRINT "PRINTING"
 0442   004E          LOCATE 20,27
 044F   004E          PRINT "SYSTEM"
 045C   004E
 045C   004E   '       draw the menu table in special graphics characters
 045C   004E          COLOR 9,0
 0468   004E          FOR I% = 18 TO 63
 046F   004E                LOCATE 2,I%:PRINT "D";
 048A   004E                LOCATE 8,I%:PRINT "D";
 04A5   004E                LOCATE 14,I%:PRINT "D";
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
 04C0  004E                LOCATE 18,1%:PRINT "D";
 04DB  004E                LOCATE 22,1%:PRINT "D";
 04F6  004E                LOCATE 24,1%:PRINT "D";
 0511  004E          NEXT I%
 0524  004E          FOR I% = 3 TO 23
 052B  004E                LOCATE I%,17:PRINT "J";
 0546  004E                LOCATE I%,64:PRINT "J";
 0561  004E          NEXT I%
 0571  004E          RESTORE TABLE
 0578  004E          FOR I% = 1 TO 12
 057F  004E                READ R%,C%,C$
 0592  0056                LOCATE R%,C%:PRINT C$;
 05AE  0056          NEXT I%
 05BE  0056
 05BE  0056          print the instructions
 05BE  0056          COLOR 7,0
 05CA  0056          LOCATE 25,6
 05D7  0056          PRINT "Use   or   to highlight menu items.  Use     to
                   activate selection.";
 05E4  0056
 05E4  0056          COLOR 15,0
";
 060A  0056          LOCATE 25,15:PRINT "";
 0624  0056          LOCATE 25,47:PRINT "DY";
 063E  0056
 063E  0056          display the 6 menu choices
 063E  0056          TEMP% = MENU%
 0645  0058          FOR MENU% = 0 TO 5
 064B  0058                GOSUB MENU.OFF
 0651  0058          NEXT MENU%
 0661  0058          MENU% = TEMP%
 066B  0058
 066B  0058          highlight the currently active menu item
 066B  0058          GOSUB MENU.ON
 066E  0058
 066E  0058          SCREEN 0,0,3,3
 0685  0058          RETURN
 0689  0058
 0689  0058    MENU.ON:'highlight the menu MENU% and display its long descript
                   ion
 068E  0058          COLOR 0,7
 069A  0058          LOCATE ARROW%(MENU%),52-LEN(MENU$(MENU%,0))/2
 06DA  0058          PRINT MENU$(MENU%,0);
 06F6  0058          COLOR 7,0
 0704  0058          LOCATE 23,40.5-LEN(MENU$(MENU%,1))/2
 0738  0058          PRINT MENU$(MENU%,1);
 0757  0058          RETURN
 075B  0058
 075B  0058    MENU.OFF:'un-highlight menu MENU% and erase long description
 0760  0058          COLOR 14,0
 076C  0058          LOCATE ARROW%(MENU%),52-LEN(MENU$(MENU%,0))/2
 07AC  0058          PRINT MENU$(MENU%,0);
 07CA  0058          COLOR 7,0
 07D6  0058          LOCATE 23,40.5-LEN(MENU$(MENU%,1))/2
```

```
Offset  Data    Source Line
 060A   0058            PRINT SPACE$(LEN(MENU$(MENUX,I)));
 062F   0058            RETURN
 0833   0058
 0833   0058    REM $PAGE
```

```
Reagent Jet Printer                                              PAGE  8
Main Line Code                                                   07-09-86
                                                                 15:27:04
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0833   0058    '******** DATA FIELDS USED BY THE MAIN PROGRAM ********
 0833   0058
 0833   0058    MENU.STRINS.DATA:       'first entry is menu name, second is lo
                ng description
 0838   0058
 0838   0058            DATA "DEFINITION", "Create and Modify Patterns"
 083A   0058            DATA "FILING",     "Delete, Copy, Rename, and Select Pa
                tterns"
 083C   0058            DATA "CALIBRATION","Calibrate and Modify Reagent Profil
                es"
 083E   0058            DATA "FILING",     "Delete, Copy, Rename, and Select Re
                agents"
 0840   0058            DATA "PRINT",      "Print Selected Pattern with Selecte
                d Reagent"
 0842   0058            DATA "EXIT TO DOS","Leave Program and Return to DOS"
 0844   0058
 0844   0058    TABLE:  'first entry is row, second is column, third is special
                 graphics character
 0849   0058
 0849   0058            DATA 2,17,"Z"
 084B   0058            DATA 2,64,"?"
 084D   0058            DATA 8,17,"C"
 084F   0058            DATA 8,64,"4"
 0851   0058            DATA 14,17,"C"
 0853   0058            DATA 14,64,"4"
 0855   0058            DATA 18,17,"C"
 0857   0058            DATA 18,64,"4"
 0859   0058            DATA 22,17,"C"
 085B   0058            DATA 22,64,"4"
 085D   0058            DATA 24,17,"Z"
 085F   0058            DATA 24,64,"Y"
 0861   0058
 0861   0058            END
 0865   0058
 0842   0058

50426 Bytes Available
47680 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

Claims

1. A dispensing system for use in diagnostic instruments for precise metering of a desired diagnostic fluid, the system comprising:
a jetting chamber defining a volume and comprising a first and second aperture, the first aperture adapted to receive diagnostic fluid, the second aperture defining an orifice;
a transducer in mechanical communication with the jetting chamber, the transducer operative to alternately expand and de-expand the volume of the jetting chamber in response to a selected electrical pulse and

thereby cause the jetting chamber to omit a substantially uniformly sized droplet of diagnostic fluid through the orifice; and

means for generating a number of electrical pulses sufficient to cause a desired quantity of the diagnostic fluid to be dispensed.

2. The invention of Claim 1 wherein the system further comprises:

at least one additional jetting chamber in fluid communication with an additional diagnostic fluid;

at least one additional transducer in mechanical communication with the additional jetting chamber;

at least one additional means for applying an electrical pulse to the additional transducer;

means for generating respective numbers of electrical pulses sufficient to cause precise quantities of the diagnostic fluids to be dispensed in a desired volumetric ratio; and

a receptacle adapted for and positioned to receive the fluids.

3. The invention of Claim 1 wherein the system further comprises:

means for directing at least one of (1) the receptacle and (2) the emitted diagnostic fluid and the emitted addi-tional diagnostic fluid such that desired quantities of the fluids are dispensed into the receptacle in a predefined dispensing order.

4. The invention of Claim 1 wherein one of the diagnostic fluids comprises serum and wherein the jetting chambers cooperate such that the other diagnostic fluid is emitted in a manner to contact and mix with the serum.

5. The invention of Claim 1 wherein the jetting chamber comprises a cylindrical tube and wherein the trans-ducer is mounted concentrically about the cylindrical tube.

6. The invention of Claim 1 wherein the jetting chamber is conically shaped.

7. The invention of Claim 1 wherein the jetting chamber comprises at least one chamber wall which is integrally formed with the transducer.

8. The invention of Claim 1 wherein the transducer is one of (1) a piezo-electric transducer; (2) a magneto-strictive transducer; (3) an electro-strictive transducer; and (4) an electro-mechanical transducer.

9. The invention of Claim 1 wherein the jetting chamber is conically shaped; and wherein the transducer is disc shaped and forms the base of the conically shaped jetting chamber.

10. The invention of Claim 1 wherein the orifice comprises an end face and the end face is coated with a hydrophobic polymer.

11. The invention of Claim 1 wherein the transducer is cylindrically shaped and comprises a first electrode located on the inner wall of the cylinder and wraps around one end of the cylinder and wherein a second electrode is located substantially on the outer wall of the cylinder and is electrically isolated from the first electrode.

12. The invention of Claim 1 wherein the means for generating produces an electrical pulse of selected rise and fall time constants and of selected duration. voltage and polarity.

13. The invention of Claim 1 wherein the means for generating the electrical pulse comprises means for scaling the voltage of the pulse in response to a selectable digital value.

14. The invention of Claim 1 wherein the apparatus further comprises means for directing the emitted diagnostic fluid along a desired path.

15. A method of dispensing precise quantities of diagnostic fluids comprising the steps of:

(a) generating an electrical pulse of predefined characteristics;

(b) reducing the volume of a chamber containing the diagnostic fluid by electro-mechanical means in response to the electrical pulse such that a droplet of fluid of known volume is propelled through an orifice in the chamber; and

(c) repeating steps (a) and (b) until a desired quantity of the diagnostic fluid has been dispensed

FIG. 1

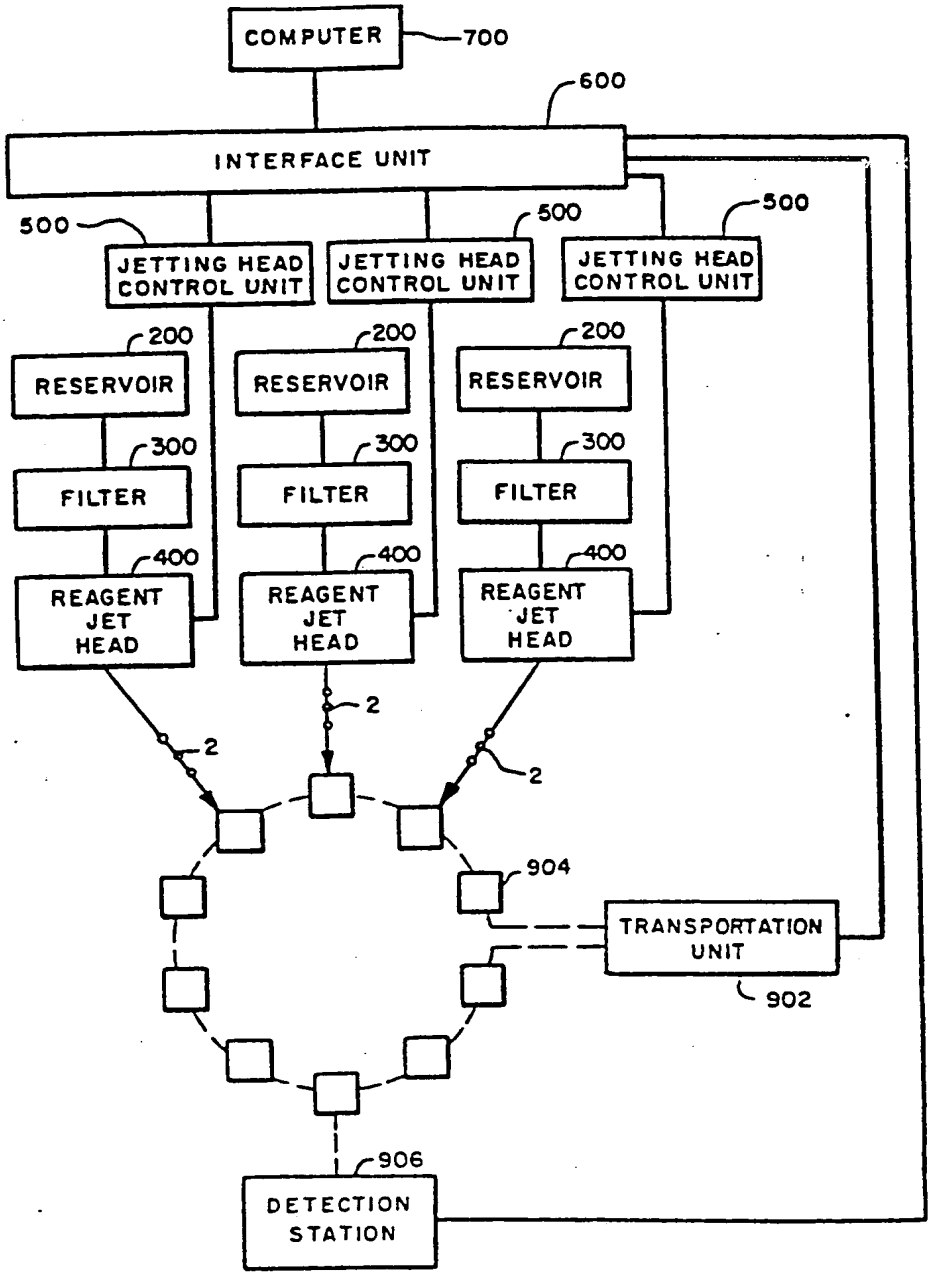

COMPUTER
700
600
INTERFACE UNIT
500
500
500
JETTING HEAD CONTROL UNIT
JETTING HEAD CONTROL UNIT
JETTING HEAD CONTROL UNIT
200
200
200
RESERVOIR
RESERVOIR
RESERVOIR
300
300
300
FILTER
FILTER
FILTER
400
400
400
REAGENT JET HEAD
REAGENT JET HEAD
REAGENT JET HEAD
2
2
2
904
TRANSPORTATION UNIT
902
906
DETECTION STATION

FIG. 2a

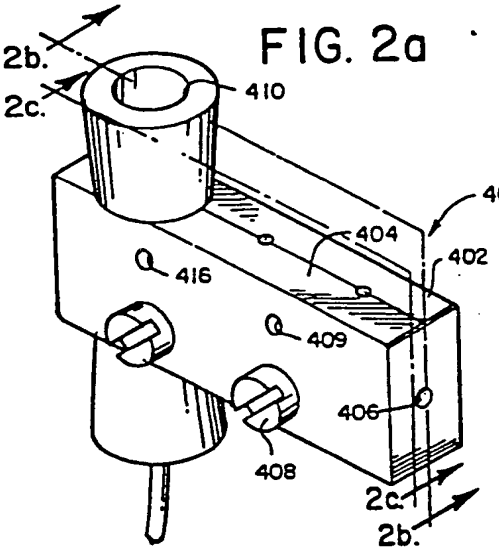


FIG. 2b

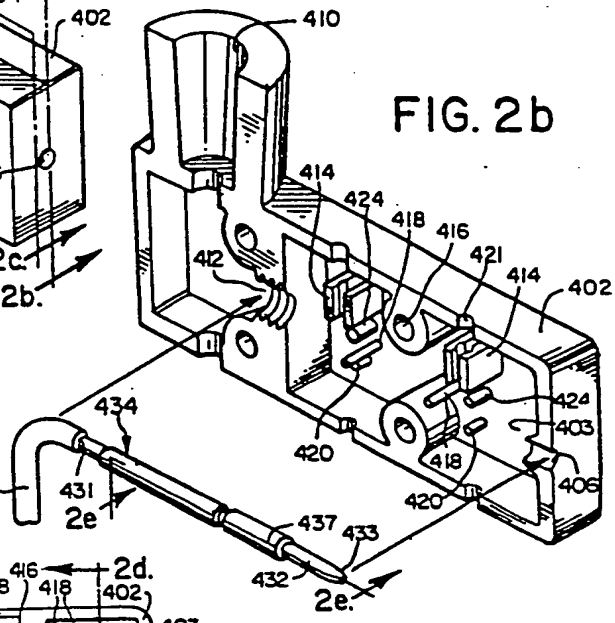


FIG. 2c

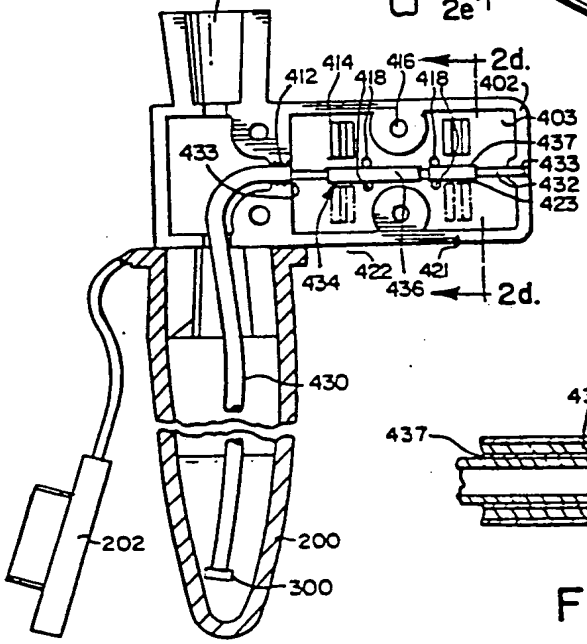
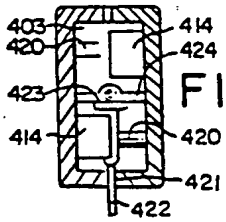


FIG. 2d



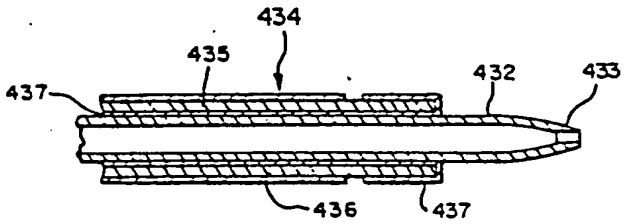


FIG. 2e

FIG. 3

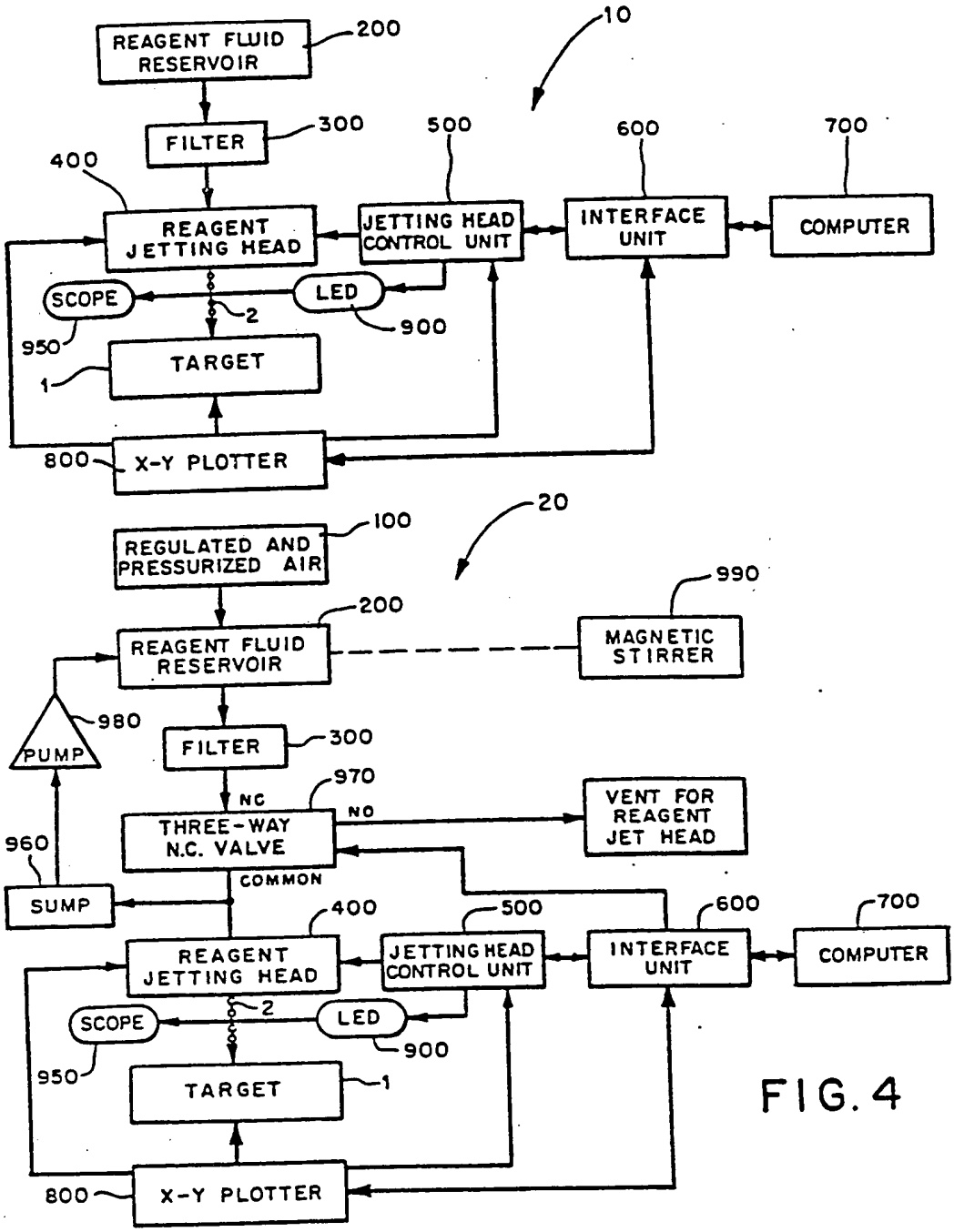

10
REAGENT FLUID RESERVOIR
200
FILTER
300
500
600
700
400
REAGENT JETTING HEAD
JETTING HEAD CONTROL UNIT
INTERFACE UNIT
COMPUTER
SCOPE
LED
2
900
950
TARGET
1
800
X-Y PLOTTER
20
REGULATED AND PRESSURIZED AIR
100
990
MAGNETIC STIRRER
980
PUMP
NC
970
NO
VENT FOR REAGENT JET HEAD
THREE-WAY N.C. VALVE
960
COMMON
SUMP

FIG. 4

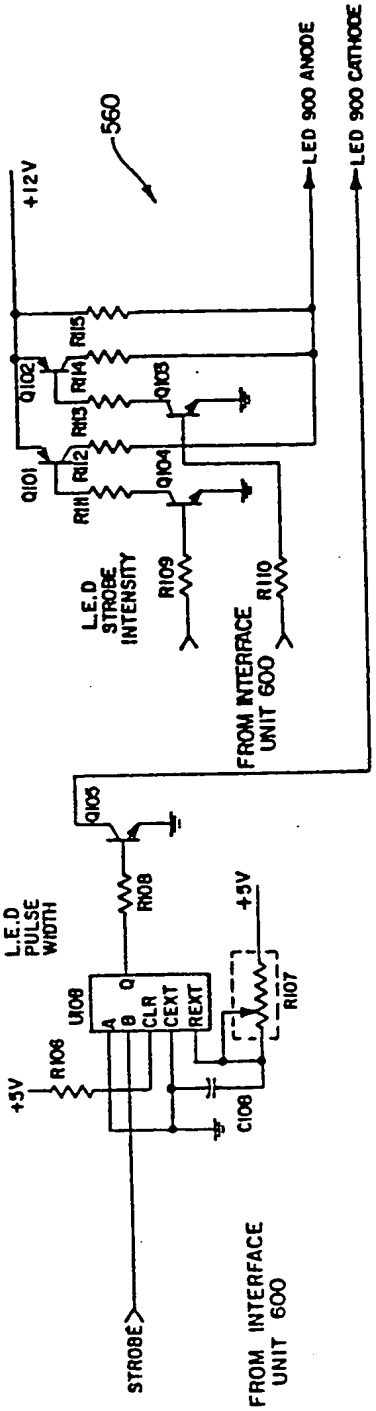

560
+12V
LED 900 ANODE
LED 900 CATHODE
Q101
Q102
Q103
Q104
Q105
R111
R112
R113
R114
R115
R109
R110
L.E.D STROBE INTENSITY
FROM INTERFACE UNIT 600
R108
L.E.D PULSE WIDTH
U108
A
B
CLR
CEXT
REXT
Q
+5V
R106
R107
C108
STROBE
FROM INTERFACE UNIT 600

FIG. 5a

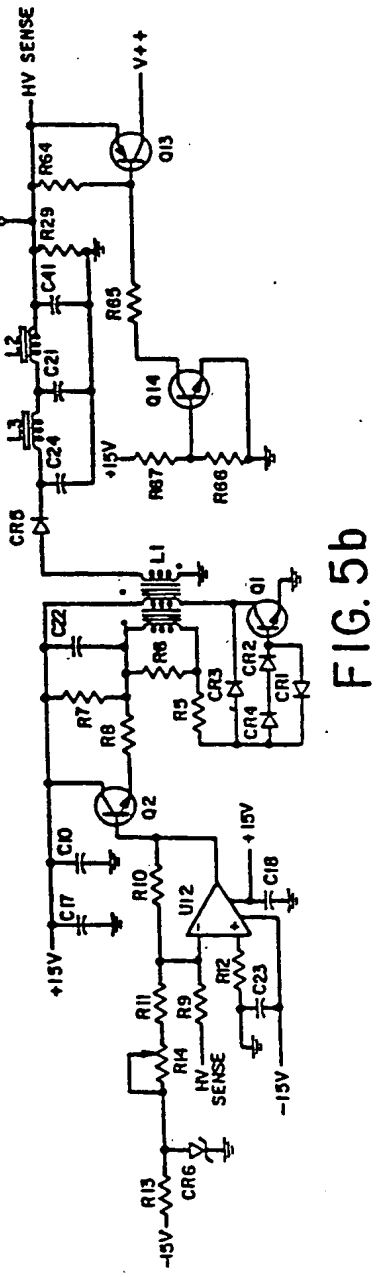

540
HV SENSE
V++
TP9
R64
Q13
R29
C41
R65
L2
C21
Q14
L3
C24
+15V
R67
R66
CR5
L1
Q1
C22
R6
CR2
CR3
CR1
CR4
R7
R5
R8
Q2
C10
C17
+15V
R10
U12
C18
+15V
R11
R9
R12
C23
R4
HV SENSE
-15V
R13
CR6
-15V

FIG. 5b

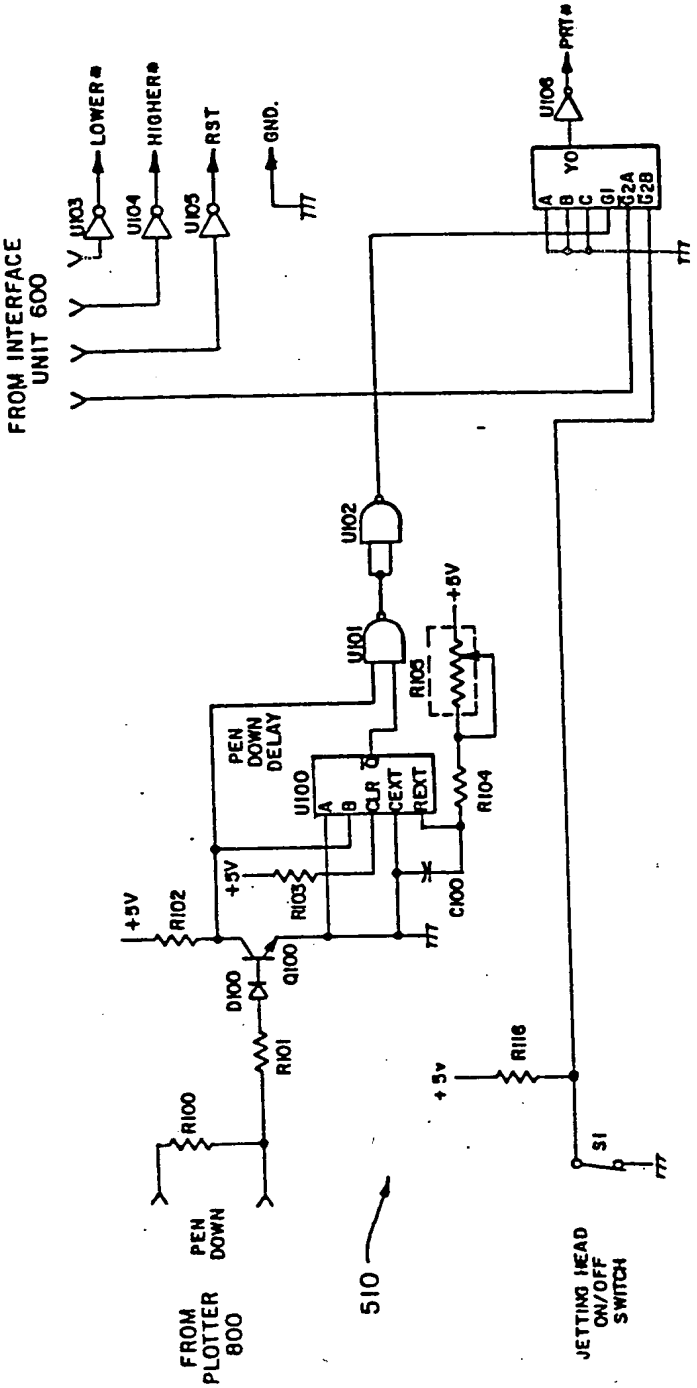

FROM INTERFACE UNIT 600
U103
U104
U105
LOWER*
HIGHER*
RST
GND.
U106
PRT*
Y0
A
B
C
G1
G2A
G2B
U102
U101
+5V
R105
R104
PEN DOWN DELAY
U100
CLR
CEXT
REXT
R103
C100
R102
Q100
D100
R101
R100
R116
S1
FROM PLOTTER 800
PEN DOWN
510
JETTING HEAD ON/OFF SWITCH

FIG. 5c

FIG. 5d

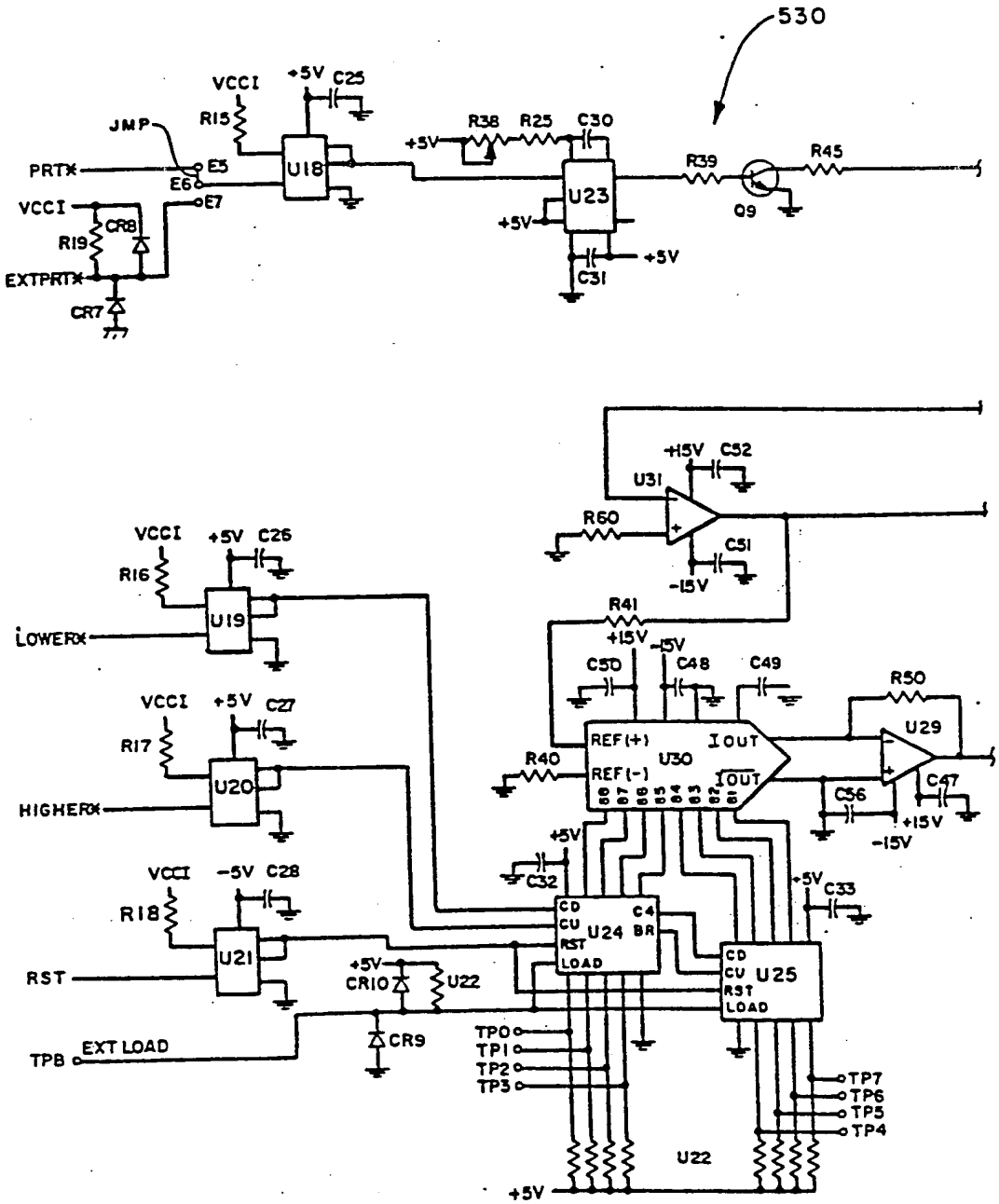

530
VCCI
+5V C25
R15
JMP
PRTX
E5
E6
E7
U18
VCCI
R19
CR8
EXTPRTX
CR7
R38 R25 C30
+5V
U23
+5V
C31
+5V
R39
Q9
R45
+15V C52
U31
R60
C51
-15V
R41
+15V -15V
C50 C48 C49
R50
U29
REF(+)
REF(-)
U30
IOUT
IOUT
R40
C56
C47
+15V
-15V
VCCI +5V C26
R16
U19
LOWERX
VCCI +5V C27
R17
U20
HIGHERX
VCCI -5V C28
R18
U21
RST
+5V
CR10
U22
CR9
TPB EXT LOAD
+5V C32
+5V C33
CD
CU
RST
LOAD
U24
C4
BR
CD
CU
RST
LOAD
U25
TP0
TP1
TP2
TP3
TP7
TP6
TP5
TP4
U22
+5V

FIG. 5e

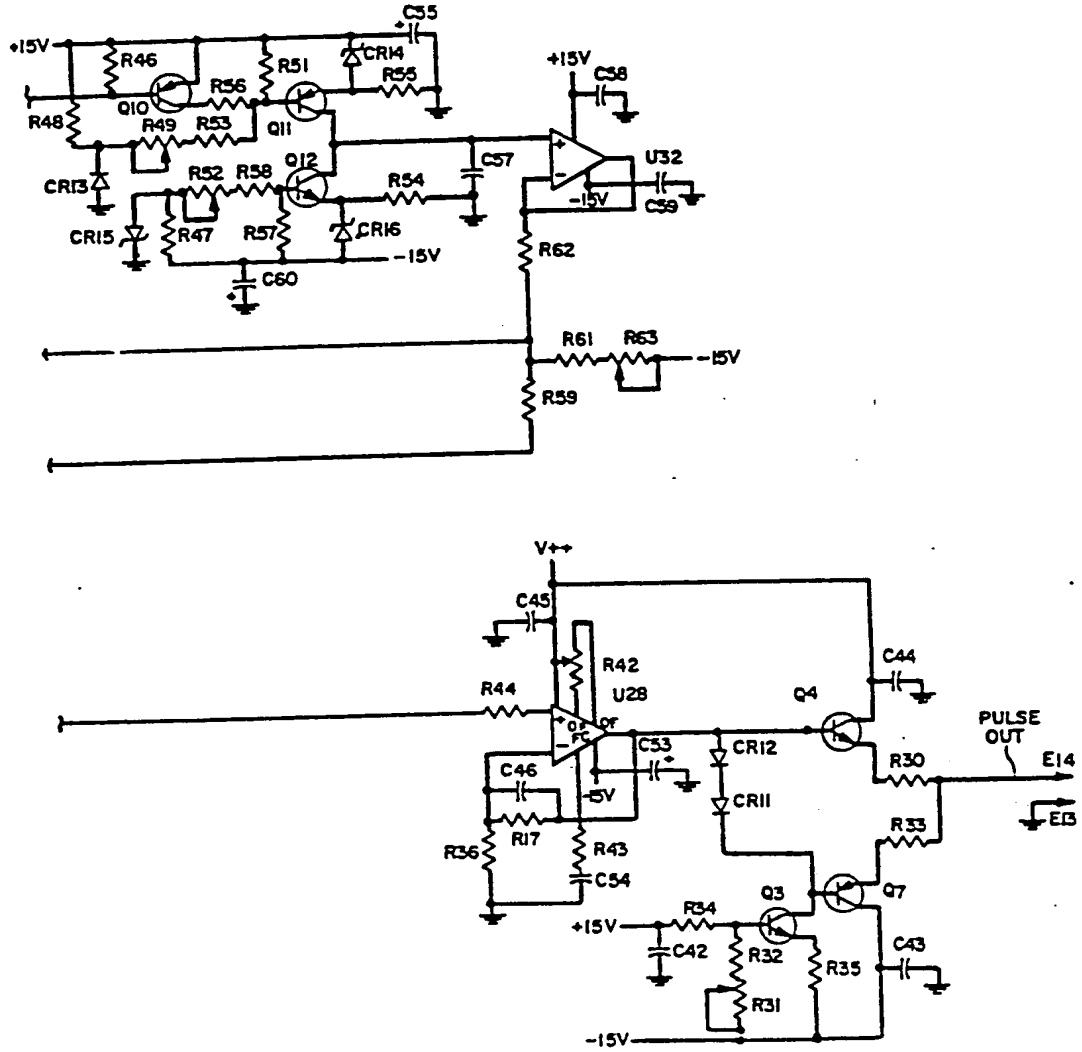

+15V
C55
R46
R51
CR14
R56
R55
Q10
Q11
R48
R49
R53
Q12
R52
R58
R54
C57
CR13
CR15
R47
R57
CR16
-15V
C60
+15V
C58
U32
-15V
C59
R62
R61
R63
-15V
R59
V++
C45
R42
U28
R44
C44
Q4
PULSE OUT
E14
E13
C53
CR12
R30
C46
-15V
CR11
R17
R43
R36
C54
R33
Q3
Q7
R34
+15V
C42
R32
R35
C43
R31
-15V

FIG. 6a

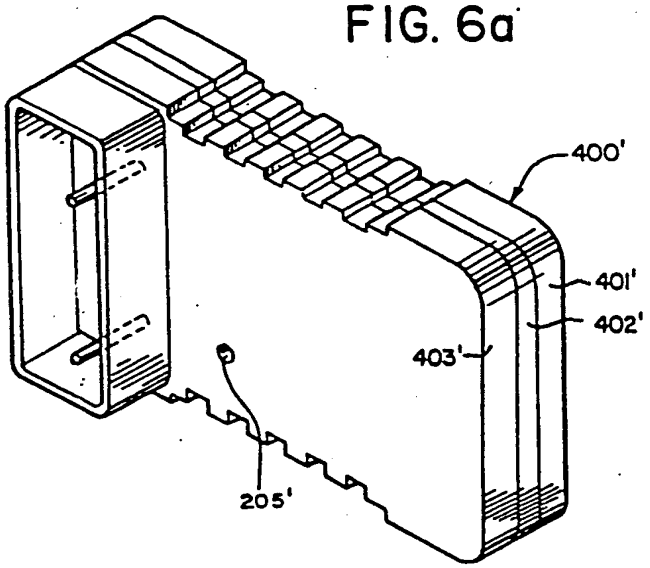


FIG. 7

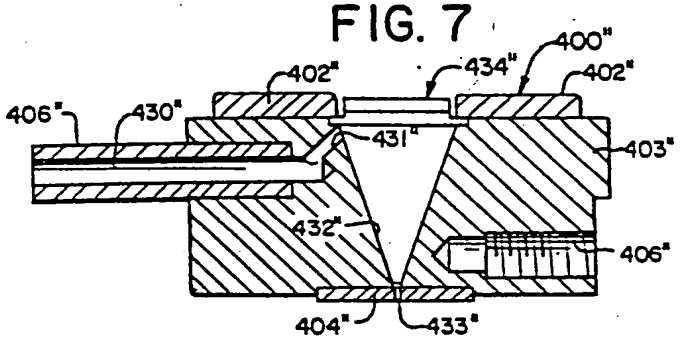
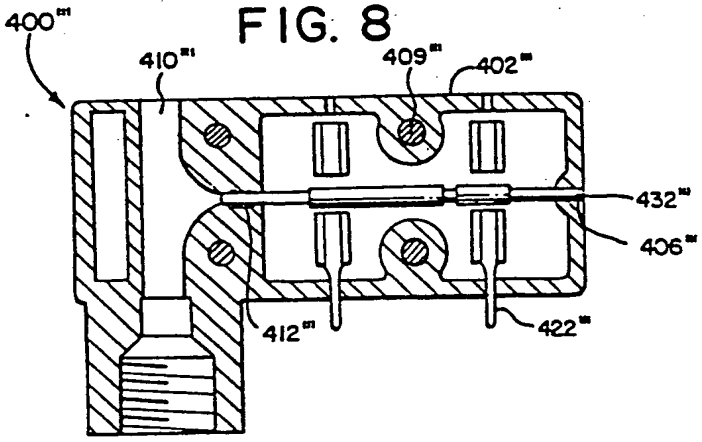


FIG. 8



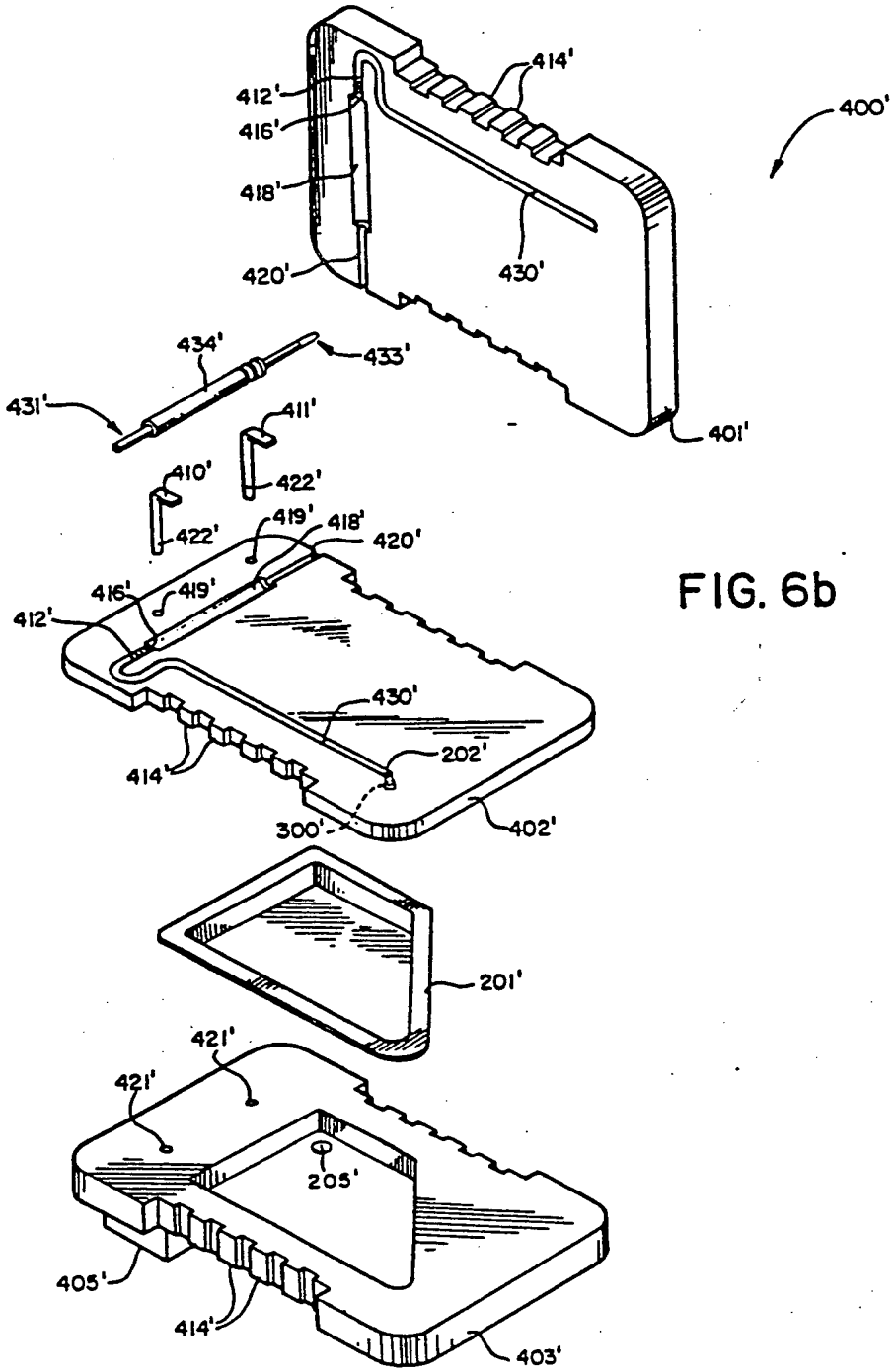

400'
414'
412'
416'
418'
420'
430'
401'
434'
433'
431'
411'
410'
422'
422'
419'
418'
420'
416'
419'
412'
430'
202'
414'
300'
402'
201'
421'
421'
205'
405'
414'
403'

FIG. 6b

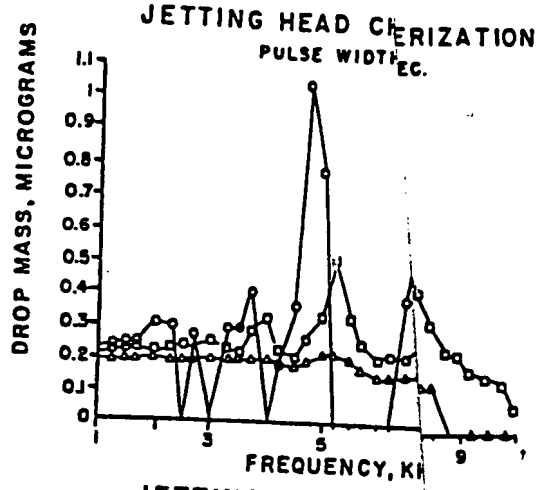


FIG. 9

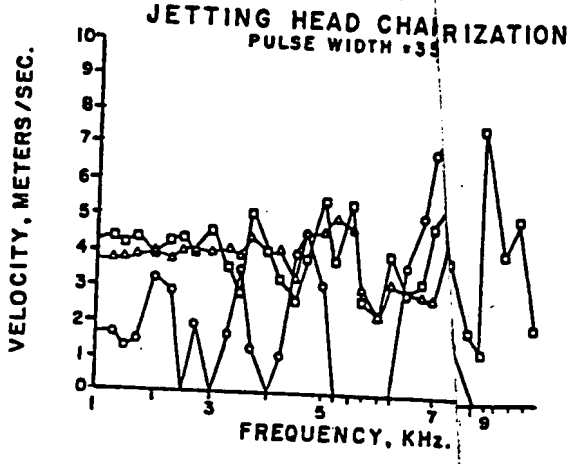


FIG. 10

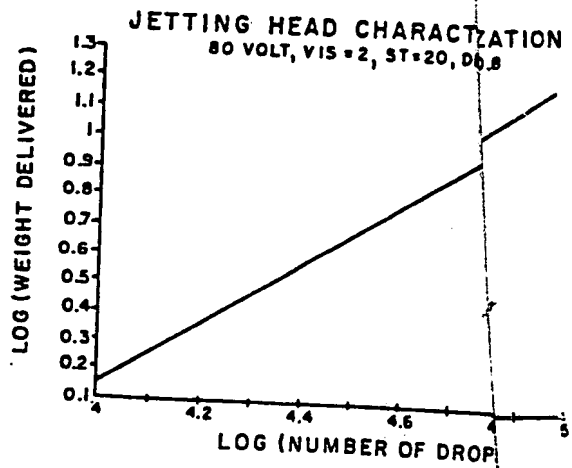


FIG. 11